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ABSTRACT

This guide is intended to assist teachers responsible for instructing future auto engine performance technicians. The following topics are covered: diagnosing engine performance problems, ignition system problems, fuel system problems, mechanically related performance problems, emission control system problems, and electronic control systems; maintaining ignitions, fuel systems, emission control systems, and electronic control systems; and conducting shop operations. The course outline is organized in the form of duty sheets. Each duty sheet contains some or all of the following: a performance objective (including a task, the source of the standard, and conditions for performance of the task); enabling objectives; resources; suggested teaching activities; a criterion-referenced measure (including questions, answers, a practical application, and a method of evaluating the practical application); and a performance checklist. The activities provided are designed to train students in the performance of job-relevant tasks. All three domains of learning--psychomotor, cognitive, and affective--are addressed. Appendixes include a cross-referenced table of duties, tasks, and performance objectives; definitions of key pertinent terms; a list of required tools, equipment, and work aids; a list of state-of-the-art literature; and a bibliography. (MN)

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V-TECS GUIDE
FOR
AUTOMOBILE ENGINE PERFORMANCE TECHNICIAN

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INTRODUCTION

V-TECS guides are an extension or continuation of the V-TECS catalogs. While the V-TECS catalog is a compilation of duties, tasks, performance objectives, and performance guides, it emphasizes the psychomotor aspect of an occupation. It is a blueprint of an occupation. It deals only with the identification of the "hands on" aspect of the occupation. It does not take into consideration such things as the background information surrounding a task, how to make inferences, generalizations and decisions from a body of knowledge, nor does it deal with attitudes, job seeking skills, safety or energy conservation practices. V-TECS guides take these aspects of teaching and learning into consideration.

Experience has shown that the art of learning can also be taught while teaching subject matter. People need to learn how to learn. V-TECS guides take into consideration how students learn and are an efficient way for instructors to assist them to learn.

V-TECS guides are centered around all three domains of learning: psychomotor, cognitive, and affective. The following is a brief explanation of each.

Psychomotor

Any manipulative skill such as tightening a nut, replacing a hubcap, sharpening a pencil, machining a key slot in a steel shaft, or replacing a SCR in a solid state control panel are examples of manipulative or psychomotor skills. Tasks such as these are identified in V-TECS catalogs. V-TECS catalogs also group tasks by duties and objectives. Each performance objective has a performance standard which must be met to prove student proficiency in the manipulative aspect of the task. The V-TECS catalog, however, does not include any suggestions as to how to learn to do these tasks.

V-TECS guides are developed around psychomotor tasks which are worker oriented.

Cognitive

To perform psychomotor tasks, students must think. To tighten a nut they must know which way to turn it and when to stop turning it so that they won't strip the threads or shear the bolt off. If replacing a hubcap, there is a certain technique that may vary from one car to another. For example, start the hubcap by placing the cap in a tilted position and tapping it all the way around until it is properly seated. On a different model, it may be necessary to position the hubcap and snap it all at once. At any rate, students must think about what is being done. This is cognition or a mental activity. Cognition is what goes on in the mind about any job being done. V-TECS guides provide both the collateral knowledge and the impetus to apply cognition to psychomotor tasks.

Students gain cognition through both real and vicarious experiences. They may read, view tapes, memorize or practice a process or procedure until they are certain of it. To test their knowledge, students may be required to decide the proper procedure, method or sequence for performance. This decision making process or cognitive activity provide the basis for higher thinking skills.

Cognition, then, is that process by which information is stored and used. That voice that warns one of potential dangers is cognition. Anything that goes on in the mind is cognition. Students may become the best workers in their job; but if they fail to think a process through and apply their experience, they may become just one more statistic. It is cognition that tells them to lock and tag out the power supply to an electrical apparatus before starting to repair it. However, cognition does not apply only to safety. Good cognition or thinking can help employees do a job better and quicker. V-TECS guides provide for the cognitive aspects of learning.

Affective

Curriculum writers, supervisors, and instructors often fail to assist students in acquiring a positive attitude toward themselves, their jobs, their school, or their fellow students. V-TECS guides seek to provide assistance to the instructor in achieving this. It is difficult for the instructor to identify little bits and pieces of desirable behavior for every unit and often harder yet to teach them. In this area, students might be judged as to how well they clean up their work area, whether they show up to do the job on time, or whether they must be told several times to do something. Potential employers are interested in student attitude because persons angry at themselves or uncertain of themselves are often poor workers.

A student's ability to succeed on the first job and every job thereafter depends largely on attitude. If, for example, students have the attitude of "let someone else do it," they could be in trouble. Students using V-TECS guides will have activities dealing with how to get along with other students, supervisors, or staff members both in large and small groups.

USE OF V-TECS GUIDE

The guide is designed to provide job-relevant tasks, performance objectives, performance guides, resources, teaching activities, evaluation standards and achievement testing in selected occupations.

A V-TECS guide is designed to be used with any teaching methods you may choose. If a lecture/demonstration method is best for you, you will find sufficient help to meet your needs. If you prefer to use discussions or other methods that require student participation, you will find ample help. Regardless of which method is successful for you, a V-TECS guide can save preparation time and offer innovative methods and procedures. For example, students may work either alone or in teams while in class and learn skills in direct relation to what is actually done on the job. This work also takes into consideration student attitudes, thinking skills, and mathematical reading skills.

The use of small groups in teaching can be helpful in two ways: (1) many students may feel inadequate due to their lack of background information in mechanical things; and (2) some students may feel that they are physically incompetent or lack the necessary background experiences. A successful program (course) can provide students with a sense of security by reinforcing positive attitudes while improving skill and knowledge of the subject. By allowing students to interact on a personal level, this task/learner-centered approach can achieve this. As students gain confidence and discover that they are an essential part of a team engaged in the learning-teaching process, their confidence increases. Too, the student in this setting can learn to work without direct supervision. In addition, use of the small-group method permits the instructor to vary instructional routines away from lecture or other full-class methods to activities for single students, pairs of students or any number so desired.

You will find suggestions for specific classroom activities. The activities are not meant to restrict you or your students, but only to suggest a variety of learning activities for each task statement. Please do not feel that you must take your students through all the activities. Although the Guide is comprehensive, teachers will be able to select the content which is applicable to the instructional offering in their schools. Teachers are encouraged to use creativity as they adopt the materials to meet the particular needs of their students.

DIAGNOSING ENGINE PERFORMANCE PROBLEMS

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 1

TASK: Identify cause of engine run-on or dieseling.

STANDARD OF PERFORMANCE OF TASK:

All causes of run-on or dieseling must be identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Timing light
Tachometer

ENABLING OBJECTIVES:

1. Use timing light, tachometer, standard tools.
2. Identify proper adjustment of timing.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Problems,** pp. 310-314, 320.

TEACHING ACTIVITIES:

1. Explain how to use engine trouble diagnosis chart.
2. List the basic engine troubles.
3. Describe the checks and correction for setting timing.
4. Discuss how to make quick checks of ignition system.
5. Describe the causes for run-on, or dieseling.
6. Demonstrate the correct hook-up for timing light and tachometer.
7. Engage the students in correct adjustment of Idle-Stop Solenoid.
8. Discuss with the students problems with diagnosis and correction.

PERFORMANCE OBJECTIVE 1

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will run-on, or diesel when:
   a. Overheating
   b. Out of time
   c. Idle-stop solenoid requires adjustment
   d. All of the above.
2. Engine backfiring may be caused by:
   a. Gas
   b. Old oil
   c. Vapor lock
   d. Incorrect timing.
3. A four (4) cylinder engine runs rough and is hard to start. The rings and valves are properly installed.
   Which of these may be true?
   a. Bent push rod
   b. Broken rings
   c. Incorrect timing
   d. Detective spark plug.

Answers:

1. d
2. d
3. c

Practical Application:

Identify engines equipped with emission control equipment and diagnose the problem with the system. Explain run-on, or dieseling and what repairs are required.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 1 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 1 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF ENGINE RUN-ON OR DIESELING

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Secured required tools and test equipment.		
2. Properly diagnosed problem.		
3. Correctly adjusted timing.		
4. Correctly used timing light and tachometer.		
5. Properly used diagnosis chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 2

TASK: Identify causes of detonation or preignition.

STANDARD OF PERFORMANCE OF TASK:

All potential causes of detonation and preignition must be checked and all abnormal conditions must be identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Timing light
Thermometer
Distributor test machine.

ENABLING OBJECTIVES:

1. Use timing light, spark plug gauge, and standard tool set.
2. Identify proper adjustment of timing, spark plug gap, and air-fuel mixture.

RESOURCES:

1. Crouse, et al., **Automotive Engine Fuels,** pp. 130-139.

TEACHING ACTIVITIES:

1. Describe the composition of gasoline additives that goes into it.
2. Explain how volatility affects engine operation.
3. Define octane rating.
4. Discuss the cause and prevention of preignition and detonation.
5. Explain why lead has been removed from some gasoline.

PERFORMANCE OBJECTIVE 2

CRITERION-REFERENCED MEASURE:

Questions:

1. Gasoline that detonates easily is called:
   a. High-octane gasoline
   b. Low octane gasoline
   c. Blended gasoline
   d. None of the above.
2. When the last part of the air-fuel mixture in the combustion chambers explodes before being ignited by flame traveling from the spark plug this condition is called:
   a. Detonation
   b. Preignition
   c. Stalling
   d. Vaporization.
3. Hydrocarbon (HC) is another name for:
   a. Water
   b. Air
   c. Exhaust gas
   d. Gasoline.

Answers:
1. b
2. b
3. d

Practical Application:
Adjust the air-fuel mixture for the proper burning in the combustion chamber and explain the compression ratio of some engines. Identify causes of detonation on preignition.

Method of Evaluating Practical Application:
Use Checklist Performance Objective 2 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 2 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSES OF DETONATION OR PREIGNITION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required tools and test equipment.		
2. Correctly adjusted plug gap.		
3. Properly followed air-fuel adjustment procedures.		
4. Properly followed procedures for setting engine on TDC.		
5. Correctly followed procedures for adjusting timing.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 3

TASK: Identify causes of stalling or rough idle when engine is cold.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Dwell meter
Tachometer
Timing light
Carburetor adjusting tool kit
Vacuum pump.

ENABLING OBJECTIVES:

1. Use carburetor float gauge, fuel pump pressure gauge.
2. Identify heat control valve, chock valve, throttle solenoid.

RESOURCES:

1. Crouse, et al., **Automotive-Engine Diagnosing Engine Troubles,** pp. 312, 319, 323.

TEACHING ACTIVITIES:

1. Explain how to use engine trouble diagnosis chart.
2. List basic engine troubles.
3. Properly describe check and corrections for six gasoline engine troubles.
4. Explain how to correctly make quick checks on fuel problems.
5. Properly demonstrate the use of float gauge.
6. Show how to properly adjust throttle solenoid.
7. Demonstrate how to properly use fuel pressure gauge.
8. Show how to properly inspect heat control valve.

PERFORMANCE OBJECTIVE 3

CRITERION-REFERENCED MEASURE:

Questions:

1. Irregular missing in different cylinders may result from:
   a. A clogged exhaust
   b. Overheated engine
   c. Defective carburetor
   d. Defective spark plug.
2. An engine will lose power (hot or cold) if it has:
   a. Incorrect idle speed
   b. Automatic choke valve stuck open
   c. Worn piston rings
   d. None of the above.
3. Failure of an engine to start even though it cranks at normal speed could be due to:
   a. Run-down battery
   b. Defective starter motor
   c. Sticking engine valve
   d. Defective ignition.

Answers:

1. c
2. c
3. d

Practical Application:

Identify causes of stalling or rough idle when engine is cold. Correct adjustments on the fast/slow speed idle mixture screw on the carburetor and make the proper adjustment on the carburetor float.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 3 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 3 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSES OF STALLING OR ROUGH IDLE WHEN ENGINE IS COLD

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required diagnosis chart.		
2. Correctly used float gauge.		
3. Properly followed procedures for adjusting float.		
4. Properly used fuel pressure gauge.		
5. Correctly adjusted throttle solenoid.		
6. Correctly inspected heat control valve.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 4

TASK: Identify causes of stalling or rough idle before engine reaches operating temperature.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Dwell meter
Tachometer
Timing light
Carburetor adjusting tool kit
Vacuum pump.

ENABLING OBJECTIVES:

1. Use standard tool kit, dwell meter tachometer, timing light and vacuum pump.
2. Identify cause for stalling and rough idle before engine warm-up.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Troubles,** pp. 312, 319.

TEACHING ACTIVITIES:

1. Explain how to identify engine problems.
2. Explain the cause of problems.
3. Describe diagnosis and correction.
4. Engage students in proper use of test equipment.
5. Engage students in proper adjustment and repair.

PERFORMANCE OBJECTIVE 4

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will stall when:
   a. Idle set too high
   b. Ignition troubles
   c. Heavy oil in crankcase
   d. Low carburetor float level.
2. After the engine is running, you engage the transmission and the engine stalls. What could be wrong?
   a. Dirty oil filter
   b. Water in oil
   c. Defective fuel pump
   d. Transmission low on fluid.
3. The engine stalls as it warms up. What could cause this?
   a. Choke valve sticks closed
   b. Anti-back fire valve closed
   c. Vapor lock
   d. PCV valve broken.

Answers:

1. d
2. c
3. a

Practical Application:

Identify causes of stalling or rough idle before engine reaches operating temperature. If the engine starts and then stalls, note whether the stalling takes place before or as the engine warms up, after idling or slow-speed driving, or after high speed or full-loaded driving. Stalling also may be caused by improper operation or adjustment of the idle solenoid.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 4 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 4 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSES OF STALLING OR ROUGH IDLING BEFORE ENGINE REACHES OPERATING TEMPERATURE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured test equipment		
2. Properly diagnosed actual course.		
3. Correctly adjusted carburetor.		
4. Properly used diagnosis chart.		
5. Properly recorded adjustment on work order.		
6. Followed procedures in repair/adjustment of contact points.		
7. Properly replaced PCV valve.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 5

TASK: Identify causes of stalling or rough idle when engine is at normal operating temperature.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Carburetor adjusting tool kit
Compression tester
Tach-dwell meter.

ENABLING OBJECTIVES:

1. Use dwell meter, tachometer and vacuum gauge.
2. Identify proper, dwell, vacuum and carburetor idle adjustment.
3. Inspect automatic choke, throttle valve for proper adjustment.
4. Inspect exhaust system for restrictions.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Trouble**, pp. 312, 318.

TEACHING ACTIVITIES:

1. Explain why an engine idles rough when it is at normal operating temperature.
2. Describe exhaust restrictions.
3. Discuss how the PCV valve operates.
4. List the engine specifications on diagnosis work chart.
5. Diagnose the cause of engine troubles.
6. Engage students in basic dwell meter hook-up.
7. Require students to perform the exhaust system check.
8. Discuss the complete diagnosis and repair with students.
9. Demonstrate each required check for problem.
10. Engage students in all required repairs and list problems and repairs on charts.

PERFORMANCE OBJECTIVE 5

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will have a rough idle when:
    a. Incorrect carburetor idle adjustment
    b. Loose or broken fan belt
    c. Engine overheats
    d. Hot spots in cylinder.
2. When a PCV valve is stuck open it will cause an engine to:
    a. Operate better
    b. Save on gasoline
    c. Run rough
    d. Vapor lock.
3. One of the problems that will cause an engine to have a rough idle is:
    a. Loss of compression
    b. Defective spark plug
    c. Valve stuck open
    d. All of the above.

Answers:

1. a
2. c
3. d

Practical Application:

Identify causes of stalling or rough idle when engine is at usual operating temperature. If the engine idles roughly but runs normally above idle, the idle speed and idle mixture may be incorrectly adjusted. A rough idle could also be due to other causes, such as a loose vacuum hose or a PCV valve that is stuck open, plus other items in the fuel, exhaust or bad fuel.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 5 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 5 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSES OF STALLING OR ROUGH IDLE WHEN ENGINE IS AT NORMAL OPERATING TEMPERATURE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured proper meter for diagnosis.		
2. Identified correct items that could be faulty.		
3. Correctly replaced faulty items.		
4. Properly adjusted carburetor.		
5. Properly used diagnosis chart in diagnosis and repair.		
6. Correctly used all meters.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 6

TASK: Identify causes of engine stumble on acceleration.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Engine analyzer or volt-ohmmeter
Tach-dwell meter
Fuel pump pressure gauge
Compression gauge
Vacuum pump.

ENABLING OBJECTIVES:

1. Use dynamometer and oscilloscope.
2. Identify proper coil voltage.
3. Inspect spark plugs heat range.
4. Take proper compression check.
5. Inspect exhaust system for clogged pipe or muffler.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Problems,** pp. 317-318.

TEACHING ACTIVITIES:

1. List the basic engine troubles.
2. Explain how to properly use dynamometer and oscilloscope.
3. Describe the checks on exhaust system.
4. Explain back pressure on engine.
5. Demonstrate proper checks on coil voltage.
6. Explain how to check proper heat range of spark plug.
7. Describe how compression checks are made and recorded.
8. Engage students in proper hook-up of dynamometer and oscilloscope.
9. Engage students in proper diagnosis of problem and repair.
10. Discuss with the students problems with diagnosis and repair.

PERFORMANCE OBJECTIVE 6

CRITERION-REFERENCED MEASURE:

Questions:

1. When an engine stumbles on acceleration it could be caused by:
   a. No fuel
   b. Improper fuel pump adjustment
   c. Defective fuel pump or PCV valve
   d. A and c.
2. An air leak at intake manifold joint will cause:
   a. Engine not to run
   b. Engine to backfire
   c. Engine to run out of control
   d. Improper acceleration.
3. Loss of engine power can be caused by:
   a. Clogged gas or exhaust lines
   b. Wrong type of fuel
   c. Worn clutch
   d. Worn fan belts.

Answers:

1. d
2. d
3. a

Practical Application:

Identify causes of engine stumble on acceleration. When an engine lacks power, it is often difficult to analyze. To get an idea of the cause, find out whether the engine lacks power when both hot or cold, or only when hot, or only when cold. Also find out if the problem developed suddenly, or if the power gradually failed over a period of many months or many miles. This condition could be due to a defective fuel pump, clogged lines, clogged filter, worn carburetor jets, or lines, air leaks at the carburetor or intake manifold joints and a sticking PCV valve. Engine worn parts can cause this problem.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 6 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 6 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF ENGINE STUMBLE ON ACCELERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Checked spark plug heat range.		
2. Checked fuel pump pressure properly.		
3. Inspected engine back pressure.		
4. Correctly used dynamometer.		
5. Correctly used oscilloscope.		
6. Properly used compression gauge.		
7. Followed correct diagnosis procedures.		
8. Properly diagnosed problems.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 7

TASK: Identify cause of engine surge at steady throttle.

STANDARD OF PERFORMANCE OF TASK:

All potential causes of engine surge at steady throttle must be checked and all abnormal conditions must be identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tach-dwell meter
Timing light
Stethoscope
Choke cleaner
Oscilloscope.

ENABLING OBJECTIVES:

1. Use a standard tool kit, tach-dwell meter, timing light, stethoscope and oscilloscope.
2. Identify the proper adjustment of timing.
3. Properly use carburetor cleaner.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Troubles,** pp. 312, 317-319.

TEACHING ACTIVITIES:

1. List the basic troubles.
2. Explain the reason for lack of engine power.
3. Describe the procedures in diagnosing problem.
4. Discuss how to make quick checks.
5. Demonstrate the correct hookup for meters.
6. Engage the students in correct adjustment, recording and repair of problems.
7. Discuss with the students problems with diagnosis and correction.

PERFORMANCE OBJECTIVE 7

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will surge at steady throttle when there is a
   - a. Defective fuel pump
   - b. Clogged filter
   - c. Worn carburetor jets
   - d. All of the above.
2. An improper adjustment on throttle linkage will permit the engine to:
   - a. Run hot
   - b. Lose fuel
   - c. Start slow
   - d. Surge.
3. When using a dwell meter the engine should be throttled at:
   - a. 800 to 900 R.P.M.
   - b. Idle
   - c. Fast idle
   - d. Book specifications.

Answers:

1. d
2. d
3. d

Practical Application:

Identify causes of engine surge at steady throttle. A tune up often will disclose various engine conditions that could cause an engine to surge.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 7 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 7 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSES OF ENGINE SURGE AT STEADY THROTTLE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required tools.		
2. Properly diagnosed problem.		
3. Properly used test equipment.		
4. Correctly listed problem on chart.		
5. Correctly installed new parts.		
6. Used proper safety procedures.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 8

TASK: Identify cause of sluggish acceleration.

STANDARD OF PERFORMANCE OF TASK:

All likely causes of sluggish acceleration must be identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Engine analyzer or timing light
Dwell meter.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use an engine analyzer.
3. Use a timing light and dwell meter.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Troubles,** pp. 312, 317-318.

TEACHING ACTIVITIES:

1. Explain how to properly select meters.
2. Explain safety procedures.
3. Discuss how to properly diagnose problems.
4. Identify engine problems on chart.
5. Demonstrate the proper hook-up of analyzer.
6. Describe the causes of sluggish acceleration.
7. Discuss proper timing and advance timing.
8. Discuss restricted exhaust system.
9. Explain catalytic converter system.

PERFORMANCE OBJECTIVE 8

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will have a sluggish acceleration when hot or cold if there is
   a. Defective restricted exhaust
   b. Throttle valve not opening fully
   c. Loss of valve action
   d. All of the above.
2. In diagnosing an engine for sluggish acceleration, you should first check:
   a. Oil in crankcase
   b. Vapor lock
   c. Solenoid
   d. Ignition.
3. In hooking up a dwell meter, you should hook the:
   a. Red wire to negative post on battery
   b. Black wire to positive post on battery
   c. Red wire to positive black to negative
   d. Red wire to coil, black to negative.

Answers:

1. d
2. d
3. d

Practical Application:

Identify cause of sluggish acceleration. When an engine start is having sluggish acceleration, it can be caused by many items, and in diagnosing the problem you should use a complete diagnosis check sheet and become familiar with each item that could cause the problem.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 8 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 8 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF SLUGGISH ACCELERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly diagnosed problem.		
2. Secured proper tool and test equipment.		
3. Correctly secured required repair parts.		
4. Followed diagnosis checklist.		
5. Properly followed safety procedures.		
6. Corrected each problem area.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 9

TASK: Identify cause of intermittent cutting out.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Engine analyzer or coil tester
Vacuum pressure gauge

ENABLING OBJECTIVES:

1. Use an engine analyzer or coil tester.
2. Use a vacuum gauge.
3. Identify coil, distributor cap, rotor and wire.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Troubles,** pp. 311, 316.

TEACHING ACTIVITIES:

1. Explain the use of engine analyzer.
2. Discuss basic engine problems.
3. Describe the difference between non-electronic ignition and electronic ignition.
4. List basic engine problems on diagnosis chart.
5. Instruct students on hook-up and correct operation of analyzer.
6. Describe primary and secondary wiring.
7. Explain vacuum pressure.
8. Engage the student in correct method of removing distributor and testing.
9. Engage student in repair of distributor.
10. Discuss fuel pump pressure.
11. Describe the electronic ignition control unit and wiring.
12. Discuss requirements for diagnosing and recording problems and corrections on diagnosis chart.

PERFORMANCE OBJECTIVE 9

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will intermittently cut out if:
   a. Piston rings are worn
   b. High octane fuel is used
   c. Distributor shaft is cracked
   d. Fuel pressure is low.
2. Non-electronic electrical systems have:
   a. No coil
   b. Point, distributor and cap
   c. Point, coil, distributor, and condenser
   d. Electronic control mode.
3. A crossfiring spark plug wire will cause an engine to:
   a. Run but miss
   b. Not start
   c. Burn valves
   d. Use more oil.

Answers:

1. d
2. c
3. a

Practical Application:

Identify cause of intermittent cutting-out. A missing engine is a rough engine. If one or more cylinder fails to fire, the engine is thrown out of balance. The result is roughness and loss of power. The cause of intermittent cutting out can be several worn or bad parts within the electrical or fuel system.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 9 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 9 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF INTERMITTENT CUTTING OUT

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required tools and meters.		
2. Properly used diagnosis chart.		
3. Properly diagnosed problem.		
4. Used proper tools.		
5. Correctly replaced worn parts.		
6. Properly adjusted timing.		
7. Followed correct procedures.		
8. Followed safety procedures.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 10

TASK: Identify cause of excessive fuel consumption.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tach-dwell meter
Oscilloscope
Compression gauge
Exhaust infra-red analyzer.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a tach-dwell meter, oscilloscope compression gauge and infra-red analyzer.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Trouble,** pp. 139, 143.

TEACHING ACTIVITIES:

1. Discuss driving habits.
2. Describe the air filter element.
3. Discuss how to inspect fuel system.
4. Demonstrate the inspection of automatic choke, EGR valve, and ignition system.
5. Explain how to check for dragging brakes, slipping clutch and restriction of exhaust system.
6. Engage students in correction and recording problems on diagnosis chart.

PERFORMANCE OBJECTIVE 10

CRITERION-REFERENCED MEASURE:

Questions:

1. What instrument can be used to determine excessive fuel consumption?
   a. Tach-dwell meter
   b. Spark plug gauge
   c. Vacuum gauge
   d. Timing light
2. What is the first step in analyzing a complaint of excessive fuel consumption?
   a. Check with dealer
   b. Talk to owner
   c. Test fuel mileage
   d. B and c above.
3. What three items can cause excessive fuel consumption?
   a. Fuel, exhaust and filtering system
   b. Fuel filtering and ignition system
   c. Fuel, engine and ignition system
   d. None of the above.

Answers:

1. c
2. d
3. c

Practical Application:

Identify course of excessive fuel consumption. The first step in analyzing a complaint of excessive fuel consumption is to make sure that the car is really having this trouble. Usually this means taking the word of the car owner. A fuel mileage tester can be used to determine accurately how much fuel the car is using.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 10 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 10 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF EXCESSIVE FUEL CONSUMPTION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	**Unsatisfactory**
1. Secured required tools and test equipment.		
2. Connected a vacuum gauge correctly.		
3. Described the checks to be made.		
4. Explained how to make quick checks.		
5. Made a cylinder leakage test.		
6. Recorded problems on diagnosis chart.		
7. Followed safety procedures.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

CHECKLIST FOR PERFORMANCE OBJECTIVE 10 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF EXCESSIVE FUEL CONSUMPTION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required tools and test equipment.		
2. Connected a vacuum gauge correctly.		
3. Described the checks to be made.		
4. Explained how to make quick checks.		
5. Made a cylinder leakage test.		
6. Recorded problems on diagnosis chart.		
7. Followed safety procedures.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 11

TASK: Identify cause of hard-starting engine (engine turns over).

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Test light
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a voltmeter, test light and standard tool kit.
2. Identify proper adjustment of voltmeter.

RESOURCES:

1. Crouse, et al., **Gasoline Fuel Trouble,** p. 140.

TEACHING ACTIVITIES:

1. Explain how to properly adjust the automatic choke.
2. Discuss the elements of accelerator pump.
3. Describe a defective distributor cap and rotor.
4. Demonstrate how to check spark at spark plug and coil.
5. Discuss compression test.
6. Explain operation of volt-meter.
7. Engage students in procedures and correction of problem.
8. Discuss problems involving diagnosis and correction.

PERFORMANCE OBJECTIVE 11

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will not start if:
    a. It is cold
    b. There is no fire at spark plug
    c. The choke is closed
    d. The air filter is removed.
2. The first procedure in checking an engine that is hard to start when warm is:
    a. Choke
    b. Fuel pump
    c. Gas tank lines
    d. PCV valve.
3. What item will cause an engine to start hard when engine is warm?
    a. Poor fuel and idle stop solenoid
    b. Overheating, defective choke and vapor lock
    c. Poor idle
    d. Defective idle mixture screw.

Answers:

1. b
2. a
3. b

Practical Application:

Identify cause of hard-starting engine (engine turnover). If the engine starts hard when warm, it could be caused by the choke sticking, closed vapor lock, or engine binding due to overheating. Choke action can be watched with the air cleaner removed. If the choke does not open wide with the engine hot, the choke should be serviced.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 11 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 11 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF HARD STARTING ENGINE (ENGINE TURN OVER)

Student's Name **Date**

DIRECTIONS TO STUDENT: Set up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured proper tools.		
2. Removed air cleaner properly.		
3. Properly diagnosed problem.		
4. Properly used diagnosis chart.		
5. Followed safety procedures.		
6. Correctly used voltmeter.		
7. Removed and installed spark plug correctly.		
8. Properly checked distributor and cap.		
9. Checked compression and recorded on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 12

TASK: Identify cause of non-starting engine.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Hydrometer
Charging-starter-battery-analyzer
Dwell meter
Timing light
Carburetor adjusting kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Inspect hydrometer, dwell-meter, timing light and volt-meter.
3. Identify proper adjustment of timing.
4. Use charging-starter-battery-analyzer.

RESOURCES:

1. Crouse, et al., **Gasoline Fuel Trouble,** pp. 137, 140.

TEACHING ACTIVITIES:

1. Explain the problem and procedures in testing.
2. Discuss the potential causes.
3. Describe equipment needed for analyzing problem.
4. Discuss diagnosis chart and recording problems.
5. List the basic engine troubles.
6. Explain safety procedures.
7. Discuss electric circuit and correct hook-up for timing light and volt-meter.
8. Discuss problems involved in diagnosis and corrections.

PERFORMANCE OBJECTIVE 12

CRITERION-REFERENCED MEASURE:

Questions:

1. If you use the wrong procedures in starting an engine it may:
   a. Run too fast and overheat
   b. Run too slow to keep running
   c. Air-fuel mixture could be too lean or too rich
   d. None of the above.
2. When the ignition system does not deliver the spark to the spark plug, you would have:
   a. Defective battery
   b. Defective battery and coil
   c. Broken plug wire
   d. Defective ignition system.
3. Today's engine requires that the owner carefully read his owner's manual because of:
   a. Driving instructions
   b. Engine design
   c. Engine starting procedures
   d. Air-fuel mixtures.

Answers:

1. d
2. d
3. c

Practical Application:

Identify cause of non-starting engine. Today's engine requires that the starting procedures as outlined in the owner's manual be followed carefully to get normal starts. If the procedures are not followed, the air-fuel mixture could be too lean or too rich to support combustion and the engine will not start. If the engine is flooded because of an improper starting procedure, crank the engine with the throttle wide open. This will clear the excess fuel from the engine and permit starting.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 12 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 12 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF NON-STARTING ENGINE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used proper procedures.		
2. Properly diagnosed problem.		
3. Recorded problem on chart.		
4. Followed safety procedures.		
5. Secured required tools and meters.		
6. Correctly used meters.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ENGINE PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 13

TASK: Identify cause of engine miss.

STANDARD OF PERFORMANCE OF TASK:

All potential causes must be checked and the actual cause identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter
Compression gauge
Oscilloscope
Test light

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Identify proper meters required to perform diagnosis.

RESOURCES:

1. Crouse, et al., **Gasoline Fuel Systems Trouble,** pp. 138, 145.

TEACHING ACTIVITIES:

1. Explain what will cause an engine to run but miss.
2. Discuss how to make quick check for problem.
3. Describe the method of diagnosing problem.
4. Demonstrate the correct hook-up for volt-ohmmeter, and oscilloscope.
5. Engage students in performing diagnosis.
6. Insure students properly record diagnosis.
7. Discuss the procedures and correction student performed.

PERFORMANCE OBJECTIVE 13

CRITERION-REFERENCED MEASURE:

Questions:

1. An engine will miss when:
   a. Muffler is defective
   b. Incorrect starting procedures are used
   c. Fuel pump is defective
   d. All of the above.
2. When missing starts you should:
   a. Check owner's manual
   b. Check fuel level
   c. Take car to a mechanic
   d. Call your dealer.
3. Incorrect float adjustment will result in:
   a. Clogged nozzle
   b. Fuel filter overflow
   c. Engine miss
   d. All of the above.

Answers:

1. c
2. c
3. c

Practical Application:

Identify cause of engine miss. If the engine runs but misses, the fuel system may be erratic in action so that fuel delivery is not uniform. This could result from clogged fuel line, clogged nozzles or passages in the carburetor, incorrectly adjusted or malfunctioning float level or needle valve in a defective fuel pump.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 13 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 13 EVALUATION:

PERFORMANCE TEST FOR IDENTIFYING CAUSE OF ENGINE MISS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required tools and test equipment.		
2. Properly used diagnosis chart.		
3. Correctly used volt-ohmmeter.		
4. Properly hooked-up oscilloscope.		
5. Followed safety procedures.		
6. Properly diagnosed and repaired system.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

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DIAGNOSING IGNITION SYSTEM PROBLEMS

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 14

TASK: Inspect distributor cap and rotor.

STANDARD OF PERFORMANCE OF TASK:

Any cracks, carbon tracks, corrosion or excessive wear of the cap or rotor must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Identify a volt-ohmmeter.
3. Identified distributor cap and rotor.

RESOURCES:

1. Crouse, et al., **Diagnosing Engine Troubles,** pp. 205, 207, 216-217.

TEACHING ACTIVITIES:

1. Explain how the rotor is attached to distributor.
2. Describe the action of rotor.
3. Explain how the electronic ignition system works.
4. Discuss the purpose of distributor cap.
5. Explain the type of distributor cap.
6. Explain primary and secondary wiring.
7. Explain use of volt-ohmmeter.
8. Engage students in inspection of distributor cap and rotor.

PERFORMANCE OBJECTIVE 14

CRITERION-REFERENCED MEASURE:

Questions:

1. A rotor rotates inside of the distributor to:
   a. Make contact with distributor cap terminals
   b. Transfers spark to coil
   c. Rotate clock-wise only
   d. None of the above.
2. When distributor cap is cracked it will cause:
   a. Engine will start but only idle
   b. Engine will run at fast idle
   c. Engine will miss on one or more cylinders
   d. Carbon up one cylinder in engine.
3. The two types of distributor caps and rotors are:
   a. Ford and General Motors
   b. Cam Non-Cam
   c. Electronic-contact-points
   d. None of the above.

Answers:

1. a
2. c
3. c

Practical Application:

Inspect distributor cap and motor. The purpose of the rotor is to connect the center terminal of the cap to the outside of the cap. The distributor cap transfers the spark through the terminal that the rotor made contact with to the spark plug wire on to the spark plug.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 14 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 14 EVALUATION:

PERFORMANCE TEST FOR INSPECTING DISTRIBUTOR CAP AND ROTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Secured proper tool kit.		
2. Inspected and checked volt-ohmmeter.		
3. Properly removed air cleaner.		
4. Examined wire towers for corrosion.		
5. Measured resistor in rotor.		
6. Removed distributor cap correctly.		
7. Recorded results on diagnosis chart.		
8. Followed safety procedures.		
9. Replaced defective parts.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 15

TASK: Inspect distributor for worn mechanical components.

STANDARD OF PERFORMANCE OF TASK:

Any mechanical defects must be detected and inspection must be in accordance with manufacturer's procedure.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Timing light

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Secure a timing light and dwell meter.

RESOURCES:

1. Stockel, et al., **Ignition System Service,** pp. 415, 433.

TEACHING ACTIVITIES:

1. Explain how to remove the air cleaner.
2. Explain the use of an ignition scope.
3. Describe the removing of distributor.
4. Discuss inspection of distributor for worn parts.
5. Demonstrate the inspection, test, and replacement of worn parts.
6. Describe the purpose of vacuum advance.
7. Explain the purpose of vacuum advance.
8. Discuss the types of distributor.
9. Engage students in inspection, testing and replacing distributor.

PERFORMANCE OBJECTIVE 15

CRITERION-REFERENCED MEASURE:

Questions:

1. The purpose of the vacuum advance is to:
   a. Advance timing
   b. Rotate the distributor
   c. Set points
   d. Change the position of the pick-up coil.
2. What are the requirements for installing distributor?
   a. Remove spark plug in number 6 cylinder
   b. Turn engine to number 1 cylinder
   c. Align the rotor with chalk or scribe mark
   d. Point rotor at number 1 cylinder.
3. Distributor must be overhauled when:
   a. Timing chain is worn
   b. Breaker points are worn
   c. Dwell is high
   d. Bushing shaft, gear or cam wear becomes excessive.

Answers:

1. a
2. c
3. d

Practical Application:

Inspect distributor for wear mechanical component. Distributor must be overhauled when bushing, shaft, gear, or cam wear becomes excessive, or when the advance mechanisms fail to function correctly. Any mechanical defect must be detected, and inspection must be in accordance to manufacturer's procedure.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 15 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 15 EVALUATION:

PERFORMANCE TEST FOR INSPECTING DISTRIBUTOR FOR WORN MECHANICAL COMPONENTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used proper safety.		
2. Correctly removed distributor.		
3. Marked rotor position.		
4. Placed distributor in vise properly.		
5. Inspected distributor shaft and gear.		
6. Checked housing bushing correctly.		
7. Inspected breaker plate in proper manner.		
8. Replaced all worn parts correctly.		
9. Installed distributor in engine properly.		
10. Set timing properly.		
11. Recorded all procedure and repair on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 16

TASK: Inspect distributor for malfunctioning electrical components.

STANDARD OF PERFORMANCE OF TASK:

Any loose connections, shorts, and broken wires must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter
Test light.

ENABLING OBJECTIVES:

1. Select the proper tool kit.
2. Use a volt-ohmmeter and test light.

RESOURCES:

1. Stockel, et al., **Ignition System Service**, p. 430.

TEACHING ACTIVITIES:

1. Explain how to properly hook up wire.
2. Discuss the problems within the distributor.
3. Describe the possible problem in breaker plate.
4. Discuss safety procedures.
5. Engage students in the procedures of testing and repair.

PERFORMANCE OBJECTIVE 16

CRITERION-REFERENCED MEASURE:

Questions:

1. Cam lubrication is required on:
    a. Breaker plate for movement
    b. Quick disconnect terminal
    c. Distributor cam lobe
    d. Help ground distributor.
2. In repairing a distributor wire you should:
    a. Replace
    b. Tape
    c. Soldier s/p
    d. None of the above.
3. Breaker point support plate lock screws are for:
    a. Installing breaker points
    b. Change dwell
    c. Point gap will not change
    d. All of the above.

Answers:

1. c
2. a
3. d

Practical Application:

Inspect distributor for malfunctioning electrical components. During the inspection of a distributor, primary wire, condenser wire and breaker plate ground wire are primary items, make certain all are correctly and firmly attached. Wire must be free of moving parts. Be certain breaker point support plate wires should be replaced.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 16 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 16 EVALUATION:

PERFORMANCE TEST FOR INSPECTING DISTRIBUTOR FOR MALFUNCTIONING ELECTRICAL COMPONENTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Checked primary wire.		
2. Secured test light and ohmmeter.		
3. Used proper test procedures.		
4. Inspected breaker plate and points.		
5. Replaced broken wire.		
6. Recorded all remarks on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 17

TASK: Test automatic spark advance/retard mechanism operation.

STANDARD OF PERFORMANCE OF TASK:

Any vacuum leaks or deviations from manufacturer's specifications for advance and retard must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tachometer
Manufacturer's specifications
Timing light with spark advance meter
Vacuum pump/gauge.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Secure a tachometer.
3. Secure and identify manufacturer's specifications.
4. Use a timing light and vacuum pump/gauge.

RESOURCES:

1. Crouse, et al., **Diagnosing Ignition System Problems,** pp. 205, 211-212, 223.

TEACHING ACTIVITIES:

1. Describe the operation of the centrifugal and vacuum advance mechanisms.
2. Explain the purpose of vacuum advance.
3. Discuss the retardation of the engine.
4. Explain the vacuum system required to operate vacuum advance.
5. Engage students in proper procedure in testing vacuum advance.
6. Engage students in adjusting the engine timing.
7. Insure students properly record diagnosis.

PERFORMANCE OBJECTIVE 17

CRITERION-REFERENCED MEASURE:

Questions:

1. The centrifugal spark-advance mechanism advance and retards the timing according to:
    a. Intake-manifold vacuum
    b. Venturi-vacuum
    c. Engine speed
    d. Throttle opening.
2. With wide-open throttle, vacuum advance will be:
    a. At a minimum
    b. Part to full
    c. At a maximum
    d. None of the above.
3. The Ford Dura-Spark II electronic module has:
    a. Mechanical advance
    b. Vacuum advance
    c. Altitude and load compensation
    d. None of the above.

Answers:

1. c
2. a
3. c

Practical Application:

Test automatic spark advance/retard mechanism operator. There are two general types of spark-advance mechanism, centrifugal and vacuum. These mechanisms vary the spark timing for different engine-operating conditions. The centrifugal-advance mechanism advances the spark plug according to the speed of the engine. The vacuum advance mechanism changes the timing of the spark as the intake-manifold vacuum and throttle-opening change.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 17 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 17 EVALUATION:

PERFORMANCE TEST FOR TESTING AUTOMATIC SPARK-ADVANCE/RETARD MECHANISM OPERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Secured required tools and test equipment.		
2. Properly removed air cleaner.		
3. Correctly connected vacuum pump.		
4. Applied vacuum and watch gauge.		
5. Recorded reading correctly.		
6. Disconnected vacuum pump properly.		
7. Set engine speed specified for full advance.		
8. Correctly read number of degree spark advance.		
9. Replaced air cleaner correctly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 18

TASK: Test primary ignition circuit.

STANDARD OF PERFORMANCE OF TASK:

Any resistance in components or wiring outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Manufacturer's manual

ENABLING OBJECTIVES:

1. Use a standard tool set.
2. Secure manufacturer's manual.

RESOURCES:

1. Crouse, et al., **Diagnosing Ignition System Problem,** pp. 205, 207.

TEACHING ACTIVITIES:

1. Explain the primary ignition circuit.
2. Describe the method of diagnosing problems.
3. Discuss the method of reading manufacturer's manual.
4. Instruct students about the proper hook-up of remote start switch.
5. Explain how to properly hook-up the voltmeter.
6. Discuss the correct way of measuring voltage.
7. Discuss correct way of measuring resistance.
8. Insure students completely understand primary circuit.
9. Engage students in performing task.
10. Discuss the procedures and correction students perform.

PERFORMANCE OBJECTIVE 18

CRITERION-REFERENCED MEASURE:

Questions:

1. The primary circuit consist of:
   a. Spark plug, wires and coil
   b. Points, primary winding in coil, battery, switch and wires
   c. Rotor, distributor, cap spark plug, points
   d. None of the above.
2. The proper resistance in primary circuit is measured with:
   a. Dwell meter
   b. Voltmeter
   c. Dwell and voltmeter
   d. None of the above.
3. The high voltage terminal is located in the primary circuit at the:
   a. Distributor
   b. Secondary side of points
   c. Spark plug
   d. Top of coil.

Answers:

1. b
2. b
3. d

Practical Application:

Test a primary ignition circuit. In order to understand the circuits in the electrical system, you must know the main parts in the circuits. The primary circuit consist of the battery, contact points, primary winding in the coil and ignition switch.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 18 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 18 EVALUATION:

PERFORMANCE TEST FOR TESTING PRIMARY IGNITION CIRCUIT

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	**Unsatisfactory**
1. Secured proper test equipment.		
2. Attached remote start switch correctly.		
3. Turned engine over until contact points closed.		
4. Connected voltmeter correctly.		
5. Followed manufacturer's specifications.		
. Recorded voltage and resistance correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 19

TASK: Test ignition coil.

STANDARD OF PERFORMANCE OF TASK:

Any deviations from manufacturer's specified resistance or scope patterns must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Engine analyzer
Volt-ohmmeter.

ENABLING OBJECTIVES:

1. Secure a standard tool kit.
2. Use engine analyzer.
3. Secure a volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Diagnosing Ignition System,** p. 206.

TEACHING ACTIVITIES:

1. Explain the purpose of ignition coil.
2. Discuss the primary winding procedure.
3. Discuss the secondary winding procedure.
4. Demonstrate testing procedures.
5. Discuss manufacturer's specifications.
6. Demonstrate how to hook-up engine analyzer.
7. Discuss coil reading on primary and secondary winding.
8. Engage students in procedures.

PERFORMANCE OBJECTIVE 19

CRITERION-REFERENCED MEASURE:

Questions:

1. The correct resistance for a coil ground from all three terminals can be located:
    a. On side of coil
    b. Oscilloscope pattern
    c. Voltmeter/ohmmeter
    d. Manufacturer's specification.
2. The ignition coil transformer:
    a. Lowers the voltage
    b. Steps up the voltage
    c. Has only 12 volts
    d. None of the above.
3. Ignition coils are known to have a:
    a. Primary winding only
    b. Secondary winding only
    c. Primary and secondary winding
    d. All of the above.

Answers:

1. d
2. b
3. c

Practical Application:

Test the ignition coil. The ignition coil transforms, or steps-up the 12 volts of the battery to the high voltage required to make current jump the spark-plug gap. The air-fuel mixture between the two electrodes presents a barrier to the passage of current. The voltage (pressure) must be very high before it can push current (electrons) from the center to the outside electrode.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 19 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 19 EVALUATION:

PERFORMANCE TEST FOR TESTING IGNITION COIL

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Secured volt-ohmmeter for testing.		
. Properly hooked-up meters.		
3. Used oscilloscope correctly.		
4. Recorded resistance properly.		
5. Read coil primary and secondary pattern on oscilloscope correctly.		
. Recorded test results properly.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 20

TASK: Inspect condition of spark plug and secondary coil wire.

STANDARD OF PERFORMANCE OF TASK:

Any defective secondary wires or terminals must be identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Identify secondary wires and terminals.

RESOURCES:

1. Crouse, et al., **Diagnosing Ignition System,** pp. 207, 210.

TEACHING ACTIVITIES:

1. Explain the purpose of the spark plug.
2. Discuss the heat range of spark plugs.
3. Show the secondary wire.
4. Demonstrate the proper way to check plug.
5. Describe the proper way to inspect wires, sealing nipple and brittle insulation.
6. Demonstrate how to identify corroded terminals.
7. Engage students in procedures.

PERFORMANCE OBJECTIVE 20

CRITERION-REFERENCED MEASURE:

Questions:

1. The heat path of a spark plug is from:
   a. Center of electrode to primary wire
   b. Center of electrode to the cooler outer shell
   c. Cylinder head to spark plug
   d. Center of electrode to the cooler outer shell of the plug to cylinder head.
2. The secondary coil wire transfers volts to:
   a. Coils
   b. Points
   c. Spark plug
   d. All of the above.
3. When a spark plug gets too hot it will cause:
   a. White or grayish cast on insulator
   b. Engine will not run
   c. Engine will run cooler
   d. All of the above.

Answers:

1. d
2. c
3. a

Practical Application:

Inspect condition of spark plug and secondary coil wire. The heat range of a spark plug tells how hot the plug gets in operation. The temperature that a plug reaches depends on how far the heat must travel. The heat path is from the center electrode to the cooler outer shell of the plug to the cylinder head. The secondary wire must be inspected for brittle insulation or worn nipples or boots.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 20 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 20 EVALUATION:

PERFORMANCE TEST FOR INSPECTING CONDITION OF SPARK PLUG AND SECONDARY WIRE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Inspected condition of spark plug and secondary wiring.		
2. Inspected for loose or corroded terminals.		
3. Checked plug for correct heat range.		
4. Recorded inspection on inspection sheet.		
5. Replaced worn or burned parts.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 21

TASK: Test resistance of spark plug wires.

STANDARD OF PERFORMANCE OF TASK:

Deviations from manufacturer's specified resistance must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturer's service manual
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use manufacturer's service manual.
3. Secure a volt-ohmmeter.

RESOURCES:

1. Stockel, et al., **Ignition System Service,** p. 421.

TEACHING ACTIVITIES:

1. Explain the characteristics of spark plug wire resistance.
2. Discuss the proper way to use ohmmeter.
3. Demonstrate the correct method of removing wire.
4. Explain manufacturer's specified resistance.
5. Explain safety procedures.
6. Discuss the reason for measuring length of wire.
7. Engage students in performing the task.
8. Discuss with the students problems in making the test.

PERFORMANCE OBJECTIVE 21

CRITERION-REFERENCED MEASURE:

Questions:

1. When making resistance test on old spark plug wire you should:
   a. Remove all wires from spark plugs
   b. Remove all wires from distributor cap
   c. Remove one wire at a time
   d. Remove only damaged wire.
2. All spark plug wires must be within:
   a. Length of old wire
   b. Within specified resistance
   c. All wires are the same resistance
   d. All of the above.
3. To determine correct resistance in spark plug wire you should:
   a. Refer to service manual for wire type
   b. Refer to service manual for wire size
   c. Refer to service manual to determine correct resistance for different length and type of wire
   d. None of the above.

Answers:

1. c
2. b
3. c

Practical Application:

Test resistance of spark plug wires. Many cars utilize special resistance type secondary wiring. In the event of ignition trouble, it is often wise to check each wire with an ohmmeter to determine if the resistance is within specified limits. This test will also show if there are breaks in the conductor, as well as poor conductor-to-terminal connections.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 21 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 21 EVALUATION:

PERFORMANCE TEST FOR TESTING RESISTANCE OF SPARK PLUG

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used proper procedures in calibrating ohmmeter.		
2. Followed service manuals procedures.		
3. Recorded correct resistance on chart.		
4. Inspected each wire one by one.		
5. Replaced wire as outlined in service manual.		
6. Properly measured each wire.		
7. Recorded test results on chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 22

TASK: Test glow plug electrical system.

STANDARD OF PERFORMANCE OF TASK:

Any component not meeting manufacturer's specifications for voltage and "on" time must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Test light
Volt-ohmmeter
Manufacturer's Service Manual.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a test light.
3. Use a volt-ohmmeter.

RESOURCES:

1. Stockel, et al., **Fuel System Service**, p. 405.

TEACHING ACTIVITIES:

1. Show how to identify the glow plug.
2. Discuss the reason for glow plug.
3. Describe how to test the glow plug.
4. Discuss how to volt test within system.
5. Explain manufacturer's specifications.
6. Discuss how to record test results on chart.
7. Engage students in procedures for testing.
8. Discuss testing and findings with students.

PERFORMANCE OBJECTIVE 22

CRITERION-REFERENCED MEASURE:

Questions:

1. Glow-plugs are used to:
    a. Open the injector
    b. Heat the injector
    c. Assist in cold starting
    d. Assist in hot starting.
2. Glow plug testing will be conducted as specified:
    a. Outlined in test manual
    b. Manufacturer's procedures
    c. Owner's manual
    d. All of the above.
3. When testing the circuit for voltage to glow plug:
    a. By-pass the power relay
    b. Never by-pass power relay
    c. Run 12 volts wire direct to glow plug
    d. None of the above.

Answers:

1. c
2. b
3. b

Practical Application:

Test glow plug electrical system. Glow plugs are used for cold starting because compression heat is not high enough to properly ignite the fuel change. A glow plug is a low voltage heating element inserted into the combustion chamber. Defective glow plug must be tested and any component not meeting manufacturer's specification for voltage and "on" time must be detected. You never by-pass the power relay.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 22 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 22 EVALUATION:

PERFORMANCE TEST FOR TESTING GLOW PLUG ELECTRICAL SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Used manufacturer's specifications.		
2. Checked fuse correctly.		
3. Properly used voltmeter in circuit.		
4. Properly activated glow plug circuit.		
5. Properly checked voltage relay.		
6. Recorded test results on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 23

TASK: Test glow plug.

STANDARD OF PERFORMANCE OF TASK:

The measured resistance of glow plug outside range specified by manufacturer must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 405-406.

TEACHING ACTIVITIES:

1. Explain the importance of a voltage test at glow plug terminal.
2. Discuss how to move glow plug.
3. Describe how to inspect heat element tip for burning or breakage.
4. Discuss resistance across terminals.
5. Explain manufacturer's specifications.
6. Discuss the value of measuring for a short between terminals and plug body.
7. Explain how to install glow plug and wire.
8. Engage students in task.

PERFORMANCE OBJECTIVE 23

CRITERION-REFERENCED MEASURE:

Questions:

1. Resistance is measured in:
   a. Amps
   b. Ohm's
   c. Volts
   d. All of the above.
2. What manual can you find the specifications for glow plugs in?
   a. Mitchell
   b. Crouse
   c. Webster
   d. Ford.
3. Measuring resistance of a glow plug is important because:
   a. Too much resistance will burn-up plug
   b. Will not burn as specified
   c. Will cause high voltage
   d. None of the above.

Answers:

1. b
2. d
3. b

Practical Application:

Test a glow plug. Glow plugs are used for cold starting because compression heat is not high enough to properly ignite the fuel charge. When working around glow plugs, some systems, using uninsulated connecting wires, current flows through the connecting resistor wires for almost two minutes after the control light goes out. Unless engine is started, the wire can be very hot so keep hands and arms away.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 23 to determine if the assignment was completed with at least a 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 23 EVALUATION:

PERFORMANCE TEST FOR TESTING GLOW PLUG

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Calibrated meter correctly.		
2. Recorded voltage at glow plug terminal properly.		
3. Used proper tool to remove glow plug.		
4. Correctly inspected heat element tip for burning or breakage.		
5. Properly used manufacturer's specification in comparing reading.		
6. Properly measured for shorts between terminal and the plug body.		
7. Installed glow plug and connected wire correctly.		
8. Correctly recorded test results on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING IGNITION SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 24

TASK: Test primary ignition resistor and resistor by-pass.

STANDARD OF PERFORMANCE OF TASK:

The measured resistance for the ballast resister, wire and switch contacts must be checked for discrepancies [beyond] the range specified by the manufacturer.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** p. 417.

TEACHING ACTIVITIES:

1. Explain the characteristics of ignition resistance.
2. Discuss the characteristics of voltage and resistance.
3. Describe the ballast resistor or resistor wire.
4. Discuss manufacturer's specifications.
5. Demonstrate the correct method of disconnecting wire from "start" position on ignition switch.
6. Explain the measured resistance of a switch contact when switch is held in start position.
7. Engage students in performing tasks.

PERFORMANCE OBJECTIVE 24

CRITERION-REFERENCED MEASURE:

Questions:

1. The ignition resistor must offer a specified amount of resistance to the:
   a. Battery-to-coil circuit
   b. Coil circuit to contact point
   c. Battery to ignition switch
   d. Coil to distributor.
2. One method of checking the wire type resistor is to:
   a. Connect voltmeter and jump wire between switch and coil
   b. Connect ohmmeter to switch and ground on battery
   c. Use voltmeter from battery to coil
   d. None of the above.
3. Ignition resistor should have no more than:
   a. 12.3 volts
   b. 6.0 volts
   c. 6.6 volts
   d. 12.0 volts.

Answers:

1. a
2. a
3. c

Practical Application:

Test primary ignition resistor and resistor by-pass. The ignition resistor (resistance wire or ballast type) must offer a specified amount of resistance to the battery-coil-circuit. Meter reading should not exceed 6.6 volts. In the event the reading is higher, replace resistance wire, and recheck reading after wire has been replaced.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 24 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 24 EVALUATION:

PERFORMANCE TEST FOR TESTING PRIMARY IGNITION RESISTOR AND RESISTOR BY-PASS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly adjusted voltmeter.		
2. Properly hooked-up voltmeter.		
3. Recorded reading on chart correctly.		
4 Properly checked ignition switch.		
5. Rechecked resistance after replacing.		
6. Used proper safety procedures.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

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DIAGNOSING FUEL SYSTEM PROBLEMS

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 25

TASK: Inspect carburetor linkage for binding or worn parts.

STANDARD OF PERFORMANCE OF TASK:

Any binding or parts worn outside of manufacturer's specifications must be identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Spray lubricant

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use carburetor spray lubricant.

RESOURCES:

1. Stockel, et al., **Auto Service Repair, p. 380.**

TEACHING ACTIVITIES:

1. Explain carburetor linkage operation.
2. Discuss cable linkage operation.
3. Discuss the free working of all linkage parts.
4. Explain the importance of free moving and nonworn parts.
5. Explain the importance of lubricant on cable and linkage.

PERFORMANCE OBJECTIVE 25 EVALUATION

CRITERION-REFERENCED MEASURE:

Questions:

1. A car with an automatic transmission, the carburetor linkage must be adjusted:
   a. With R.P.M.
   b. With speed of car
   c. Exact
   d. With automatic speed control.
2. Cable operated linkage should be inspected for:
   a. Free movement
   b. Lubrication
   c. No worn parts
   d. All of the above.
3. When lubricant is used on linkage you should never put lubricant on:
   a. Idle screws
   b. Throttle shaft
   c. Control valve
   d. Throttle plate.

Answers:

1. c
2. d
3. b

Practical Application:

Inspect carburetor linkage for binding or worn parts. On some cars with automatic transmission, adjustment of the throttle linkage must be exact. (Adjust as specified). Check linkage (rod or cable) for possible binding, kinking, or interference. Lubricate all joints and make sure cotter pin and clips are in place. Never oil the carburetor throttle shaft, automatic choke, or choke shaft. Oil will collect dust and cause sticking.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 25 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 25 EVALUATION:

PERFORMANCE TEST FOR INSPECTING CARBURETOR LINKAGE FOR BINDING OR WORN PARTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Secured required tools and lubricant.		
2. Properly inspected for worn parts.		
3. Properly disconnected gas pedal cable.		
4. Properly inspected for free movement.		
5. Properly lubricated required parts.		
6. Used proper safety procedures.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 26

TASK: Check for vacuum leaks.

STANDARD OF PERFORMANCE OF TASK:

All vacuum leaks must be detected and identified.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Vacuum gauge
Pinch off pliers.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a vacuum gauge.
3. Use pinch off pliers.

RESOURCES:

1. Stockel, et al., **Auto Repair and Service**, pp. 501-502.

TEACHING ACTIVITIES:

1. Discuss how to identify vacuum leak problem.
2. Explain the reason for vacuum gauge.
3. Demonstrate how the vacuum gauge is used.
4. Explain the importance of vacuum.
5. Describe the locations of vacuum.
6. Discuss the requirement to isolate the exact cause.
7. Explain the proper way to correct vacuum leak.
8. Engage students in task.

PERFORMANCE OBJECTIVE 26 EVALUATION

CRITERION-REFERENCED MEASURE:

Questions:

1. A vacuum gauge should be connected to:
   a. Engine intake manifold
   b. Carburetor
   c. Engine exhaust manifold
   d. Vacuum booster.
2. When making a cranking vacuum test, you should:
   a. Remove spark plug,
   b. Cut off vacuum supply to booster,
   c. Remove coil wire,
   d. All of the above.
3. Vacuum reading will help pinpoint trouble areas, but you should:
   a. Replace PCV valve to insure reading is correct;
   b. Conduct other appropriate test before final decision;
   c. Utilize low and high reading to be correct;
   d. All of the above.

Answers:

1. a
2. c
3. b

Practical Application:

Check for vacuum leaks. Excess air leaking into the system will upset the fuel mixture. Vacuum leaks can cause trouble such as rough idle, missing on acceleration, and burned valves. If the leak exists in some accessory units, such as the power brake, or vacuum advance, the unit will not function correctly. Vacuum leaks must be fixed.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 26 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 26 EVALUATION:

PERFORMANCE TEST FOR CHECKING FOR VACUUM LEAKS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly hooked-up vacuum gauge.		
2. Recorded first low-high reading.		
3. Recorded manufacturer's specification.		
4. Isolated problem correctly.		
5. Corrected cause of problem.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 27

TASK: Check carburetor air filter.

STANDARD OF PERFORMANCE OF TASK:

Any obstruction or blockage of air cleaner element, fuel leaks, binding, sticking, missing or damaged linkage to the carburetor must be detected.

SOURCE OF STANDARD:

Writing team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Shop light.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a shop light.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 408-410.

TEACHING ACTIVITIES:

1. Explain the types of air filter element.
2. Discuss the purpose of air filter.
3. Discuss the maintenance of air filter.
4. Discuss possible damage to air filter.
5. Engage students in performing task.

PERFORMANCE OBJECTIVE 27

CRITERION-REFERENCED MEASURE:

Questions:

1. At what intervals should the dry paper filter be replaced?
   a. Monthly
   b. Bi-monthly
   c. Specified intervals
   d. Never.
2. The cleaning procedures for a polyurethane filter are:
   a. Wash with mild detergent and water;
   b. Wash element out in gasoline;
   c. Wash or soak in solvent or kerosene;
   d. All of the above.
3. While inspecting an air filter you find the body of the air cleaner half full of oil. What should you know or do?
   a. It's a polyurethane filter;
   b. Engine is using oil;
   c. Filter needs replacing;
   d. Its a oil bath filter.

Answers:

1. c
2. c
3. d

Practical Application:

Check carburetor air filter. The air filter is very important to the operation of the engine and should be inspected on specified intervals. Filters that have any obstruction or blockage should be replaced. Identification of the air filter is very important to the maintenance of the filter. Cleaning procedure must be followed.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 27 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 27 EVALUATION:

PERFORMANCE TEST FOR CHECKING CARBURETOR AIR FILTER

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly removed filter.		
2. Identified type of filter.		
3. Properly inspected filter for obstruction or blockage.		
4. Made visual check of carburetor for leaks.		
5. Properly cleaned filter.		
6. Reinstalled filter correctly.		
7. Recorded information on work chart.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 28

TASK: Check anti-dieseling devices.

STANDARD OF PERFORMANCE OF TASK:

Anti-dieseling device that does not function to manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Fuel, Lubricating and Cooling,** p. 92.

TEACHING ACTIVITIES:

1. Discuss anti-dieseling problems.
2. Explain the operation of anti-dieseling solenoid.
3. Demonstrate correct adjustment.
4. Explain the inspection and testing of solenoid.
5. Discuss manufacturer's specifications.
6. Explain recording of specifications and findings.
7. Engage students in performance of the task.
8. Discuss corrections and repairs.

PERFORMANCE OBJECTIVE 28

CRITERION-REFERENCED MEASURE:

Questions:

1. Anti-dieseling is also called:
   a. Backfire
   b. Low timing
   c. Run on
   d. All of the above.
2. Anti-dieseling solenoid controls the:
   a. Amount of fuel to fuel pump.
   b. Amount of fuel to carburetor.
   c. Closing of throttle valve.
   d. Accelerator plunger.
3. During normal operation, the solenoid pulls in its plunger so that:
   a. Engine will run a fast idle;
   b. Normal fuel flow at idle;
   c. Engine will shut off;
   d. Throttle plate will shut off air supply.

Answers:

1. c
2. c
3. b

Practical Application:

Check anti-dieseling devices. To prevent dieseling, many carburetors are equipped with an anti-dieseling solenoid. Its job is to control the closing of the throttle valve. When the engine is running the solenoid is connected to the battery. It will extend a plunger. The plunger serves as the idle stop and prevents complete closing of the throttle.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 28 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 28 EVALUATION:

PERFORMANCE TEST FOR CHECKING ANTI-DIESELING DEVICE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located anti-dieseling device.		
2. Properly inspected device.		
3. Used volt-ohmmeter correctly.		
4. Located manufacturer's specifications.		
5. Properly adjusted solenoid.		
6. Recorded reading properly on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 29

TASK: Check accelerator pump operation.

STANDARD OF PERFORMANCE OF TASK:

Accelerator pump discharge outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Shop light

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a shop light.

RESOURCES:

1. Stockel, et al., **Auto Repair and Service,** pp. 375-376.

TEACHING ACTIVITIES:

1. Explain the purpose of accelerator pump.
2. Discuss how the fuel flows into the air horn.
3. Explain how to adjust linkage on pump.
4. Discuss how to identify stuck or clogged check valve or nozzle.
5. Explain the diaphragm operation.
6. Engage students in the performance of the task.

PERFORMANCE OBJECTIVE 29

CRITERION-REFERENCED MEASURE:

Questions:

1. When checking the pump discharge nozzle in the air horn, you should check for:
   a. Air in air horn,
   b. Engine is running at high idle,
   c. One or more streams of fuel,
   d. All of the above.
2. The correct way to check the accelerator pump is to:
   a. Run engine at high idle, then accelerate;
   b. Open throttle, from idle to full open. (Engine stopped) quickly;
   c. Open throttle, from idle to full open. (Engine running) slowly;
   d. Make sure the carburetor is full of gas.
3. If a small amount of fuel is noticed when you are making your check, you could have:
   a. Cracked or worn diaphragm,
   b. Worn linkage,
   c. Dirt in nozzle,
   d. All of the above.

Answers:

1. c
2. b
3. d

Practical Application:

Check accelerator pump operation. When checking the accelerator pump, you open the throttle, from idle to full open (engine stopped), quickly. While observing the pump nozzle design, one or more streams of gas should be evident. The fine gas stream should be strong and should last for a short time even after the throttle reaches full open. If little of no gas output is noticed, the accelerator pump piston leather (or diaphragm, if of that type) could be cracked or worn. Check valve could be stuck open by dirt or the discharge nozzle fuel system could be clogged.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 29 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 29 EVALUATION:

PERFORMANCE TEST FOR CHECKING ACCELERATOR PUMP OPERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used tools properly.		
2. Inspected carburetor correctly.		
3. Removed air cleaner properly.		
4. Checked pump nozzle correctly.		
5. Checked for cracked or worn leather.		
6. Properly replaced a repair pump.		
7. Correctly recorded finding on chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 30

TASK: Check fuel supply to carburetor.

STANDARD OF PERFORMANCE OF TASK:

Lack of specified quantity of fuel being supplied to carburetor must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.
Fuel pump pressure and volume gauge.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a fuel pump pressure and volume gauge.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair**, pp. 350-352.

TEACHING ACTIVITIES:

1. Explain the value of fuel system service.
2. Show the components of fuel system.
3. Explain how to setup for checking fuel pump pressure and volume.
4. Explain the elements of a filter system.
5. Explain how to identify electrical fuel gauge.
6. Engage students in the performance of the task.
7. Discuss student responses on the task.

PERFORMANCE OBJECTIVE 30

CRITERION-REFERENCED MEASURE:

Questions:

1. When checking fuel pump volume, manufacturer's specifications will generally call for a flow equivalent to:
   a. 1 pint per 2 minutes at 400 RPM,
   b. 3/4 quart per 1 minute at 500 RPM,
   c. 1 quart per 2 minutes at 1000 RPM,
   d. 1 quart per 1 minute at 500 RPM.
2. When the supply of fuel to the carburetor is less than required you should:
   a. Fill gas tank,
   b. Check vent tube,
   c. Check fuel pump filter and lines,
   d. Both b and c above.
3. Before working on the tank sending unit you are required to:
   a. Turn key to off position,
   b. Remove fuel cap,
   c. Remove battery ground strap,
   d. Disconnect fuel line from tank.

Answers:

1. d
2. d
3. c

Practical Application:

Check fuel supply to carburetor. Fuel tanks are constructed of treated steel or plastic. When you have a lack of fuel being supplied to the carburetor you must detect what the cause may be by making several checks. By making a volume check you can determine if the fuel filter is clogged during your other check. Determine if the fuel pump is defective or lines from the gas tank are clogged.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 30 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 30 EVALUATION:

PERFORMANCE TEST FOR CHECKING FUEL SUPPLY TO CARBURETOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Checked fuel in tank.		
2. Inspected fuel lines.		
3. Properly used volume gauge.		
4. Removed fuel line from carburetor correctly.		
5. Properly checked fuel filter.		
6. Properly used assistant in measuring fuel from system.		
7. Recorded manufacturer's specified time for discharging fuel into container.		
8. Properly used all safety procedures.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 31

TASK: Test electric fuel pump operation.

STANDARD OF PERFORMANCE OF TASK:

Electric fuel pump operation outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Fuel pressure gauge

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a fuel pressure gauge.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 351, 354.

TEACHING ACTIVITIES:

1. Explain the operation of fuel pressure pump.
2. Discuss manufacturer's specifications for fuel pressure.
3. Explain safety procedures for electric fuel pump.
4. Discuss different types of fuel pump.
5. Demonstrate the test procedures for fuel pump.
6. Discuss how to operate the fuel pump and verify fuel pressure.
7. Explain recording test results on work chart.
8. Engage students in the performance of the task.

PERFORMANCE OBJECTIVE 31

CRITERION-REFERENCED MEASURE:

Questions:

1. The electric fuel pump comes in how many types:
   - a. 2
   - b. 6
   - c. 4
   - d. 1
2. Which type of electric fuel pump is mounted inside of the gas tank:
   - a. Roller-vane
   - b. Bellows
   - c. Diaphragm
   - d. Impeller.
3. Fuel pressure must be determined by:
   - a. Factor
   - b. Manufacturer's specifications
   - c. Dealer
   - d. All of the above.

Answers:

1. c
2. d
3. b

Practical Application:

Test electric fuel pump operations. Electric fuel pumps come in diaphragm, bellows, impeller, and roller-vane type. Accurate pressure and volume test depend on a properly charged battery and mechanically sound motor or solenoid. Check wires for good condition. The electric pump is placed inside the gas tank. When stopped, there is no residual line pressure. As part of a thorough tune up, or when carburetion difficulties exist, the fuel pump should be checked for leaks, output pressure, flow volume, and inlet vacuum.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 31 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 31 EVALUATION:

PERFORMANCE TEST FOR TESTING ELECTRIC FUEL PUMP OPERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly set-up fuel pump pressure and volume gauge.		
2. Recorded reading on chart correctly.		
3. Inspected electrical wiring correctly.		
4. Insured battery was at full surge.		
5. Inspected fuel lines from tank to carburetor.		
6. Followed safety procedures.		
7. Used manufacturer's specification.		
8. Properly explained vapor lock.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 32

TASK: Test mechanical fuel pump operation.

STANDARD OF PERFORMANCE OF TASK:

Volume and pressure outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Fuel pressure gauge.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a fuel pressure gauge.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 351, 354.

TEACHING ACTIVITIES:

1. Explain the different types of mechanical fuel pumps.
2. Explain the operation of mechanical fuel pump.
3. Discuss the repair of fuel pump (non-sealed).
4. Show the elements in repair kits for fuel pumps.
5. Explain manufacturer's specifications requirement.
6. Discuss fuel pressure and volume.
7. Explain safety procedures.
8. Engage students in task performance.

PERFORMANCE OBJECTIVE 32

CRITERION-REFERENCED MEASURE:

Questions:

1. In repairing a fuel pump, you should use:
   a. Only parts required,
   b. Complete repair kit,
   c. Diaphragm kit,
   d. Rocker arm assembly.
2. The first requirement in checking the fuel pump is to:
   a. Render ignition system inoperative;
   b. Disconnect fuel line carburetor;
   c. Check fuel in tank;
   d. All of the above.
3. Fuel pump pressure should be as outlined in:
   a. Dealer manual
   b. Owner's manual
   c. Manufacturer's specification
   d. Pressure reading only.

Answers:

1. b
2. b
3. c

Practical Application:

Test mechanical fuel pump operation. As part of thorough tune up, or when carburetion difficulties exist the fuel pump should be checked for leaks, out put pressure flow volume, and inlet vacuum. Inspect lines for kinks, dents or leaks, make sure there is ample fuel in the tank. Clean or replace fuel filter. Mechanical fuel pump can sometimes be replaced. A diaphragm kit contains a pump diaphragm, valve, pulsation diaphragm, diaphragm rod, oil seal and gasket. Additional items come in a complete repair kit. These tests will have a diaphragm spring rocker arm, pin and spring.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 32 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 32 EVALUATION:

PERFORMANCE TEST FOR TESTING MECHANICAL FUEL PUMP OPERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly explained safety procedures.		
2. Explained vapor lock.		
3. Serviced fuel filter correctly.		
4. Removed and inspected fuel pump correctly.		
5. Replaced fuel pump as directed.		
6. Checked fuel pressure correctly with fuel gauge.		
7. Recorded procedure and reading on work chart correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 33

TASK: Test mechanical fuel injection system.

STANDARD OF PERFORMANCE OF TASK:

Any defects in mechanical fuel injection timing, volume or pressure not within manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use required special equipment as required by the manufacturer.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 386-387.

TEACHING ACTIVITIES:

1. Explain mechanical fuel injection construction, operation and service.
2. Describe the different types of filters.
3. Discuss the reason for precise adjustments.
4. Explain the importance of checking the condition hose and tubing.
5. Explain part and full load adjustment.
6. Discuss injector service.
7. Engage students in performing task.

PERFORMANCE OBJECTIVE 33

CRITERION-REFERENCED MEASURE:

Questions:

1. Prior to servicing a fuel injection system you should check for:
    a. Faulty injector,
    b. Full load adjustment,
    c. Linkage adjustment,
    d. Condition of all hose and tubing.
2. The adjusting devices in the fuel system provides:
    a. One time fuel adjustment,
    b. Part and full load adjustment,
    c. Allows more fuel load adjustment,
    d. Pump output.
3. When pump seems noisy, you should check:
    a. Electrical connections
    b. Linkage
    c. Rubber mounting (when used)
    d. Fuel lines

Answers:

1. d
2. b
3. c

Practical Application:

Test mechanical fuel injection system. The mechanical fuel injection system uses an engine drive injector pump, an electric fuel filter and draws the gasoline from the tank through a series of pistons and cams which compresses a measured quantity of gasoline and delivers it to a specific injector. The injector valve can be tested for leakage, proper opening pressure, and spray pattern shape. Use an injector test unit. Replace faulty valves, when installing the injector. Use new seal rings and torque to manufacturer's specification.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 33 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 33 EVALUATION:

PERFORMANCE TEST FOR TESTING MECHANICAL FUEL INJECTION SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly checked fuel supply to injection system.		
2. Properly checked fuel supply to injector.		
3. Measured fuel discharge volume, timing and pressure per manufacturer's procedures correctly.		
4. Properly tested fuel spray pattern.		
5. Correctly recorded test result on diagnosis chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 34

TASK: Test electric fuel injection system.

STANDARD OF PERFORMANCE OF TASK:

Electric fuel injection system timing, pressure and volume not within manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use special equipment as required.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 387-388.

TEACHING ACTIVITIES:

1. Explain the reason for electronic fuel injection.
2. Discuss the operation of the electronic system.
3. Explain the numerous systems.
4. Discuss the reason for classification of system into two basic types.
5. Discuss intermittent injection and continuous injection.
6. Explain the maintenance required on the electronic fuel system.
7. Engage students in performing the task.

PERFORMANCE OBJECTIVE 34

CRITERION-REFERENCED MEASURE:

Questions:

1. The two classified electronic injection systems are:
   - a. Mechanical/injector system
   - b. Electrical/mechanical
   - c. Intermittent/continuous
   - d. All of the above.
2. In the intermittent system, the injector valves are opened for a:
   - a. Very brief period of time,
   - b. Exact time with exhaust stroke,
   - c. Milliseconds,
   - d. Full stroking period.
3. The intermittent system joins the injectors in groups of:
   - a. 4
   - b. 8
   - c. 6
   - d. 2 plus at a time.

Answers:

1. c
2. a
3. d

Practical Application:

Test electric fuel injection system. The electrical fuel injection system does not use a mechanical injector pump. It relies on an electric fuel pump to provide the needed pressure. While there are numerous electronic fuel injection systems they can be classified under two basic types; intermittent injection and continuous injection.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 34 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 34 EVALUATION:

PERFORMANCE TEST FOR TESTING ELECTRIC FUEL INJECTION SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly checked supply to injection system.		
2. Properly checked fuel supply to injector		
3. Correctly measured fuel discharge volume timing and pressure as per manufacturer's specifications.		
4. Properly tested fuel injector spray pattern.		
5. Properly tested electrical components.		
6. Recorded test results on diagnosis chart correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 35

TASK: Test throttle body fuel injection system.

STANDARD OF PERFORMANCE OF TASK:

Throttle body fuel injection system functions outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use special equipment required by the manufacturer.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 388, 399.

TEACHING ACTIVITIES:

1. Discuss the throttle body injector system.
2. Explain manufacturer's requirement and specification.
3. Discuss the reason for measuring fuel pressure and volume.
4. Explain the reasons for testing electrical components.
5. Explain the importance of recording correct reading.
6. Engage students in the performing of the task.

PERFORMANCE OBJECTIVE 35

CRITERION-REFERENCED MEASURE:

Questions:

1. The throttle body injector system is closed as a:
    - a. Full flow system
    - b. Fuel pump system
    - c. Efficient system
    - d. Typical system.
2. When removing fuel injector from throttle body you should:
    - a. Drain fuel line,
    - b. Test injector,
    - c. Avoid damaging unit,
    - d. All of the above.
3. When checking fuel pressure and volume you will need:
    - a. Quart bottle
    - b. Specifications
    - c. Meter
    - d. Injector service unit.

Answers:

1. c
2. c
3. b

Practical Application:

Test throttle body fuel injection systems. The throttle body fuel injection system discharges fuel into the throttle body area just above the throttle valve. The fuel as needed by the cylinders is drawn through the intake manifold much as in the case of a carbureted engine. This too is a very efficient system.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 35 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 35 EVALUATION:

PERFORMANCE TEST FOR TESTING THROTTLE BODY FUEL INJECTION SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly inspected throttle body.		
2. Properly checked fuel pressure to nozzle.		
3. Correctly used manufacturer's specifications.		
4. Properly used electrical test equipment.		
5. Correctly recorded results on work order chart.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING FUEL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 36

TASK: Test diesel fuel injection system.

STANDARD OF PERFORMANCE OF TASK:

Diesel fuel injection system functions outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use special equipment as required by manufacturer.

RESOURCES:

1. Stockel, et al., **Auto Repair and Service,** p. 400.

TEACHING ACTIVITIES:

1. Explain the importance of verifying fuel supply to injection system.
2. Discuss the value of verifying fuel supply to injector piston.
3. Explain the correct method of measuring discharge volume, pressure and timing as specified.
4. Explain the injector spray pattern.
5. Discuss the value of testing an individual component as required by the manufacturer's specifications.
6. Review the requirement for recording the findings on the work chart.

PERFORMANCE OBJECTIVE 36

CRITERION-REFERENCED MEASURE:

Questions:

1. The difference between mechanical gasoline injection and diesel fuel injection is:
    a. Injected into cylinder
    b. Injected into intake manifold
    c. Injected into port injector
    d. All of the above.
2. Diesel fuel injection pump is driven by:
    a. Distributor shaft
    b. Direct connection to belt, chain or gear
    c. Gear only
    d. All of the above.
3. The requirement for the high pressure at the injector is:
    a. Injection direct to cylinder,
    b. Diesel will burn at low compression,
    c. High pressure to discharge circuit,
    d. Transfer pressure delivery valve.

Answers:

1. a
2. b
3. c

Practical Application:

Test diesel fuel injection system. The diesel engine injection system differs from the mechanical gasoline fuel injection in three respects.

1. Diesel fuel is injected directly into the cylinder combustion area.
2. Injection must be timed to the compression stroke, and the fuel pressure required is much, much higher.
3. Fuel must be injected into the combustion chamber area at the height of compression. This requires tremendous pressure.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 36 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 36 EVALUATION:

PERFORMANCE TEST FOR TESTING DIESEL FUEL INJECTION SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly verified fuel supply to injection system.		
2. Correctly recorded fuel supply to injector.		
3. Verified the correct measurement to injector discharge volume pressure and timing.		
4. Properly checked injector spray pattern.		
5. Correctly checked individual components as required by manufacturer specifications.		
6. Correctly recorded all test procedures and measurements properly on work chart.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DIAGNOSING MECHANICALLY-RELATED PERFORMANCE PROBLEMS

DUTY: DIAGNOSING MECHANICALLY - RELATED PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 37

TASK: Check for brake dragging.

STANDARD OF PERFORMANCE OF TASK:

Any dragging of the brakes must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Identify proper procedures for chart recording.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 698, 719.

TEACHING ACTIVITIES:

1. Explain the safety procedures for using hoist.
2. Explain the causes of dragging brakes.
3. Define the difference between disc and drum brakes.
4. Explain the reason for tapping drum and caliper.
5. Discuss correct adjustment on drum brakes.
6. Demonstrate correct adjustment on dragging drum brakes.
7. Engage students in adjustment.
8. Ensure correct recording is completed on chart.

PERFORMANCE OBJECTIVE 37

CRITERION-REFERENCED MEASURE:

Questions:

1. The hydraulic hoist has a ________________ lock for safety:
   a. Air
   b. Oil
   c. Mechanical
   d. Air over oil.
2. When adjusting a drum brake you should:
   a. Remove drum and make adjustment;
   b. Rotate drum until adjustment is made;
   c. Adjust wheel bearing after adjustment is made;
   d. All of the above.
3. When your brakes start dragging you should check:
   a. Parking brake adjustment,
   b. Check hose and line,
   c. Brake adjusted too tight,
   d. All of the above.

Answers:

1. c
2. c
3. d

Practical Application:

Check for brake dragging. A minor brake adjustment means adjusting the shoes toward the drum to make up for lining wear. With the wheel free of the ground parking brake disconnected, remove the star wheel adjustment slot cover. It may be in the backing plate or drum. With a brake adjustment tool turn the adjusting star wheel in direction needed to loosen or tighten brakes. Do not adjust too close, the brakes may drag, heat up, lock.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 37 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 37 EVALUATION:

PERFORMANCE TEST FOR CHECKING BRAKE DRAGGING

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used hoist properly.		
2. Properly checked master cylinder.		
3. Checked drum and caliper correctly.		
4. Properly rotated each wheel.		
5. Properly checked for resistance.		
6. Correctly adjusted each drum.		
7. Recorded malfunction on work chart correctly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING MECHANICALLY-RELATED PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 38

TASK: Check for restricted exhaust.

STANDARD OF PERFORMANCE OF TASK:

Any obstructions, kinks, dents or other restrictions in the exhaust system must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Identify proper procedures for chart recording.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 871, 877.

TEACHING ACTIVITIES:

1. Explain the safety procedures for raising car on hoist.
2. Explain the inspection procedures for a restricted exhaust system.
3. Discuss the separation of exhaust manifold, muffler and catalytic converter.
4. Explain why exhaust pipe and tail pipe should be probed with heavy wire.
5. Discuss the back pressure on engine.
6. Engage students in task performance.
7. Review student recordings on the work charts.

PERFORMANCE OBJECTIVE 38

CRITERION-REFERENCED MEASURE:

Questions:

1. When an engine lack's power, you should check:
   a. Leak in muffler,
   b. Tail pipe does not protrude far enough to rear or side of car,
   c. Clogged or kinked exhaust or tail pipe,
   d. Oil drip on hot exhaust system.
2. When muffler becomes clogged it will cause:
   a. Less back pressure in muffler,
   b. Less engine efficiency,
   c. Pressure build up in engine,
   d. B and c above.
3. When inspecting the exhaust system the catalytic converter is only part of:
   a. Converter testing,
   b. Converter service life,
   c. Complete exhaust system,
   d. All of the above.

Answers:

1. c
2. d
3. c

Practical Application:

Check for restricted exhaust. When inspecting the exhaust system for restriction, dents, obstruction and kinks, you should remember that any restriction within the system will cause lack of engine efficiency. Also when regular gas is used in an unleaded engine, the lead will cause damage to the converter and can soon clog the converter causing excessive exhaust system back pressure, engine damage, poor performance and a decrease in gas mileage.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 38 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 38 EVALUATION:

PERFORMANCE TEST FOR CHECKING RESTRICTED EXHAUST

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Used safety procedures correctly.		
2. Inspected complete system properly.		
3. Removed exhaust pipe from manifold correctly.		
4. Correctly used heavy wire probe.		
5. Correctly checked catalytic converter.		
6. Reconnected complete system correctly.		
7. Recorded any malfunction on work chart properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING MECHANICALLY-RELATED PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 39

TASK: Check for clutch/transmission slippage.

STANDARD OF PERFORMANCE OF TASK:

Any slippage of the clutch or automatic transmission beyond manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Identify the transmission.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 529, 620.

TEACHING ACTIVITIES:

1. Discuss the purpose of transmission (manual and automatic).
2. Explain the reasons for clutch slippage (manual and automatic).
3. Discuss pedal free travel.
4. Discuss the basics for oily facing and a worn clutch plate.
5. Explain weak pressure plate springs.
6. Explain hydraulic and mechanical linkage.
7. Explain the purpose of road testing.
8. Discuss engine flare.
9. Engage students in task performance.

PERFORMANCE OBJECTIVE 39

CRITERION-REFERENCED MEASURE:

Questions:

1. Before adjusting clutch pedal free travel depress the clutch to which position?
    a. Adjustment/position
    b. Height/travel
    c. Release/travel
    d. Free play/release.
2. Prior to making adjustment, you should:
    a. Hoist car so wheels will rotate,
    b. Set parking brake,
    c. Road test,
    d. Lubricate linkage.
3. The two types of linkage are:
    a. Manual/power
    b. Hydraulic/mechanical
    c. Slave/drive
    d. None of the above.
4. Before road testing an automatic transmission car, you need to check:
    a. Gear selector
    b. Fluid
    c. Linkage
    d. Hold brake and run engine at high throttle.

Answers:

1. a
2. c
3. b
4. b

Practical Application:

Check for clutch/transmission slippage. When making adjustment of clutch fire travel, you should make sure the clutch pedal is in the fully released position and that it is firmly against the pedal stop. The measured distance the pedal moves from the fully extended position to the point at which the release fingers are engaged represents the amount of free travel. Average free travel is 1 inch (25.4 mm). Be sure to check specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 39 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 39 EVALUATION:

PERFORMANCE TEST FOR CHECKING FOR CLUTCH/TRANSMISSION SLIPPAGE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly checked transmission before road test.		
2. Properly road tested automatic transmission car.		
3. Properly checked clutch free travel.		
4. Properly checked engine flare.		
5. Compared stall test engine speed with manufacturer's specification correctly.		
6. Used gear selector from 1st to 2nd gear properly.		
7. Properly recorded malfunction on work chart.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING MECHANICALLY-RELATED PERFORMANCE PROBLEMS

PERFORMANCE OBJECTIVE 40

TASK: Check for internal engine wear.

STANDARD OF PERFORMANCE OF TASK:

Any internal engine wear which degrades roadability and performance below manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Compression gauge
Source of compressed air

ENABLING OBJECTIVES:

1. Use a tool kit.
2. Use a compression gauge.
3. Use an air line from the compressor.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair**, pp. 251, 500.

TEACHING ACTIVITIES:

1. Demonstrate the use of compression gauge.
2. Discuss how to perform a leakdown test.
3. Show how to remove a leakdown test.
4. Identify valve lifter and worn cam lobes to students.
5. Explain the removing of timing chain cover.
6. Discuss the wear on timing gear and chain.
7. Inspect rocker arms for wear.
8. Engage students in recording malfunction and repair.

PERFORMANCE OBJECTIVE 40

CRITERION-REFERENCED MEASURE:

Questions:

1. Before taking compression check you must first:
   - a. Remove spark plug,
   - b. Engine at normal operating temperature,
   - c. Remove air cleaner,
   - d. None of the above.
2. By removing the valve cover you can:
   - a. Check lifter,
   - b. Visually inspect timing gear,
   - c. Check valve lift wear,
   - d. All of the above.
3. With timing chain cover removed you can:
   - a. Inspect front main bearing,
   - b. Check rocker arm wear,
   - c. Timing gear teeth,
   - d. Water pump.

Answers:

1. b
2. c
3. c

Practical Application:

Check for internal engine wear. When making a compression test, you must operate the engine until normal operating temperature is reached. Remove all spark plugs from the cylinder head along with air cleaner. Open the throttle valve to the wide open position. The choke must also be fully open. Insert compression gauge into the 1st cylinder and record reading by turning engine over. Each cylinder must be checked in the same manner. Remove timing cover and inspect chain and gear for wear. Visually inspect both camshaft and camshaft gear. If cam gear obviously worn, replace it.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 40 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 40 EVALUATION:

PERFORMANCE TEST FOR CHECKING FOR INTERNAL ENGINE WEAR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Performed compression test correctly.		
2. Properly performed leak down test.		
3. Removed valve cover as instructed.		
4. Properly checked valve lift wear.		
5. Correctly removed timing cover to check timing chain and sprocket teeth for wear.		
6. Inspected rocker arm for wear correctly.		
7. Recorded all malfunctions on work chart correctly.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 41

TASK: Test PCV system.

STANDARD OF PERFORMANCE OF TASK:

Any deviation from PCV system manufacturer's specifications for opening and closing vacuum must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use special equipment as required by the manufacturer.

RESOURCES:

1. Crouse, et al., **Automotive Engine,** p. 258.

TEACHING ACTIVITIES:

1. Describe the operation of the PCV system.
2. Discuss the three positions of the PCV valve.
3. Explain why control of fuel-vapor emission is needed.
4. Describe the difference between crankcase storage and canister storage of fuel vapor.
5. Demonstrate how to locate the parts of the PCV system on various engines.
6. Demonstrate how to locate the parts of the fuel-vapor emission-control system on various engines.
7. Explain the opening and closing vacuum.
8. Engage students in task performance.

PERFORMANCE OBJECTIVE 41

CRITERION-REFERENCED MEASURE:

Questions:

1. The PCV valve is part of the:
   a. Fuel system
   b. Lubrication system
   c. Emission control system
   d. Exhaust manifold.
2. The loss of vacuum on a emission control engine will cause:
   a. Water to remain in engine
   b. Sludge can clog oil lines
   c. Corrode engine parts
   d. All of the above.
3. The letter PCV stands for:
   a. Pollution control vapor
   b. Pressure-vacuum-cap
   c. Positive crankcase ventilation
   d. None of the above.

Answers:

1. c
2. d
3. c

Practical Application:

Test PCV valve. The PCV valve controls the flow of crankcase vapor in accordance with ventilation requirement for different engine speed and loads. When the engine is running, air must circulate through the crankcase. The circulating air removes the water and liquid gasoline that appear in the crankcase when the engine is cold. When blowby gases are removed from the crankcase, sludge and acids will form. Sludge can clog oil lines and starve the lubricating system which could ruin the engines.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 41 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 41 EVALUATION:

PERFORMANCE TEST FOR TESTING PCV SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly inspected vacuum system.		
2. Made proper inspection for leaks.		
3. Properly tested PCV or PCV tester.		
4. Idled engine to correct speed during test.		
5. Properly used manufacturer's specifications.		
6. Properly checked air filter and cleaner.		
7. Recorded test results on work chart correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 42

TASK: Check idle speed control system.

STANDARD OF PERFORMANCE OF TASK:

Any deviations of idle speed from manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer
Tachometer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use special equipment required by manufacturer.
3. Use a tachometer.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 366-367.

TEACHING ACTIVITIES:

1. Explain the characteristics of an idle speed control system.
2. Discuss the difference between cold and hot idle adjustment.
3. Show the location of idle cam linkage.
4. Demonstrate how to locate automatic choke linkage.
5. Show the idle mixture screw.
6. Discuss manufacturer's specifications.
7. Engage students in task performance, have them record adjustments and tachometer reading.

PERFORMANCE OBJECTIVE 42

CRITERION-REFERENCED MEASURE:

Questions:

1. Slow idle (hot idle) speed adjustment is made with the engine:
   a. Cold
   b. Normal temperature
   c. At high idle
   d. Normal operated speed.
2. With a vacuum emergency brake you should:
   a. Block wheels and put transmission in neutral,
   b. Disconnect vacuum line and insert vacuum gauge,
   c. Attach tachometer to vacuum emergency brake hose,
   d. None of the above.
3. When finished setting hot idle speed, you should:
   a. Adjust throttle valve
   b. Adjust automatic choke
   c. Adjust speed control
   d. Immediately adjust idle mixture.

Answers:

1. b
2. b
3. d

Practical Application:

Check idle speed control system. The idle speed control system is part of the tune up procedure. When adjustment is made, you must adjust the idle when the engine is cold and when at normal temperature. The adjustments are located on the carburetor. Because the fast idle cam position is determined by the degree of choke valve opening, it is important that the relationship is accurate. When adjustment is required on slow idle, your engine must be at normal operating temperature. Check specification to determine if the automatic transmission should be in drive or neutral.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 42 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 42 EVALUATION:

PERFORMANCE TEST FOR CHECKING IDLE SPEED CONTROL SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Attached vacuum gauge correctly.		
2. Properly attached tachometer.		
3. Correctly recorded manufacturer specification's.		
4. Adjusted fast idle cam linkage properly.		
5. Set slow idle as required.		
6. Adjusted idle mixture screw properly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 43

TASK: Check operation of preheated air intake.

STANDARD OF PERFORMANCE OF TASK:

Any deviation in pre-heated air intake functions from manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Read and interpret manufacturer's specifications.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** p. 848.

TEACHING ACTIVITIES:

1. Explain the purpose of pre-heat air intake.
2. Discuss removing hoses or tubes so control valve operation can be observed or felt.
3. Explain how to place the valve in a position to admit heated air.
4. Observe engine warming up to normal operating temperature.
5. Discuss the position of a valve, when it blocks heated air and receives air from atmosphere.
6. Engage students in task performance.

PERFORMANCE OBJECTIVE 43

CRITERION-REFERENCED MEASURE:

Questions:

1. The heat control valve provides heat to:
   a. Help vaporize the fuel charge in warm up,
   b. Control fuel,
   c. Control vacuum,
   d. Controls carburetor.
2. The heat control valve can be controlled by:
   a. Muffler
   b. Converter
   c. Vacuum
   d. Speed of engine.
3. Heat control valve can be incorporated into:
   a. Exhaust pipe
   b. Intake manifold
   c. Converter
   d. Exhaust manifold and exhaust pipe.

Answers:

1. a
2. c
3. d

Practical Application:

Check the operation of a preheated air intake. The heat control valve provides heat to help vaporize the fuel charge during engine warm up. A heat control valve may be installed in the exhaust manifold. It may also be between the exhaust manifold and exhaust pipe. The valve can be actuated by a bimetallic spring or by vacuum motor.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 43 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 43 EVALUATION:

PERFORMANCE TEST FOR CHECKING OPERATION OF PRE-HEATED AIR INTAKE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly removed hose and pipe so control valve operation could be observed or felt.		
2. Correctly started cold engine.		
3. Properly observed valve operation.		
4. Properly checked engine in warm-up.		
5. Made proper remark on work chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 44

TASK: Check exhaust gas recirculation system.

STANDARD OF PERFORMANCE OF TASK:

Any deviations in exhaust gas recirculation system functions at manufacturer's specified vacuum and engine temperature must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Vacuum gauge
Auxiliary vacuum source

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a vacuum gauge.
3. Use an auxiliary vacuum source.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair**, p. 863.

TEACHING ACTIVITIES:

1. Explain the purpose of EGR valve.
2. Discuss how to test the EGR valve.
3. Explain the reason for auxiliary vacuum source.
4. Discuss why the engine will lose about 200 RPM when EGR diaphragm is depressed.
5. Engage students in task performance.

PERFORMANCE OBJECTIVE 44

CRITERION-REFERENCED MEASURE:

Questions:

1. When EGR valve diaphragm is depressed the engine will:
    a. Run rough
    b. Speed up
    c. Backfire
    d. Lose 500 RPM.
2. You never disconnect or render the EGR valve inoperative on a ________________ basis.
    a. Temporary
    b. Permanent
    c. Immediate
    d. Operating
3. When replacing the EGR valve, you should make sure:
    a. Correct size
    b. Proper type
    c. Diaphragm types
    d. Like make.

Answers:

1. a
2. b
3. b

Practical Application:

Check exhaust gas recirculation system. When testing the EGR valve, the test technique should conform to the valve type at hand. Test valve action with the engine at operating temperature unless checking action of a thermal vacuum switch. Depress the EGR diaphragm with the tip of your fingers. If the engine was idling smoothly, it should immediately lose about 200 rpm and show signs of roughness. If this happens, the EGR valve is correct at that point.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 44 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 44 EVALUATION:

PERFORMANCE TEST FOR CHECKING EXHAUST GAS RECIRCULATION SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	**Unsatisfactory**
1. Checked EGR valve correctly.		
2. Checked EGR valve at normal operating temperature.		
3. Properly checked EGR valve with vacuum gauge.		
4. Properly checked engine with auxiliary source applied to EGR valve for rough idle or stall.		
5. Properly recorded malfunctions on work chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 45

TASK: Check air pump.

STANDARD OF PERFORMANCE OF TASK:

Air pump functions outside of manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Read and interpret manufacturer's specifications.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 856-857.

TEACHING ACTIVITIES:

1. Explain the correct adjustment for air pump belt.
2. Discuss the reason for opening and closing the throttle fully at normal operating temperature and listening for the diverter valve to dump pressure as RPM's drop.
3. Discuss why manifold source valve hose is disconnected to diverter valve and why hose is plugged.
4. Explain why increasing engine RPM is required to dump pressure.
5. Engage students in task performance and discuss the malfunctions he has recorded.

PERFORMANCE OBJECTIVE 45

CRITERION-REFERENCED MEASURE:

Questions:

1. What type air pump is used on automobiles for air injection?
   a. Vane
   b. Rotor
   c. Pressure
   d. Control.
2. When check valve is forced off its seat by pump air pressure, it allows the air to enter:
   a. Air cleaner
   b. Distribution manifold
   c. Air switch valve
   d. Exhaust valve.
3. Exhaust gases are prevented from flowing in the hose pump by:
   a. Check valve
   b. Exhaust valve
   c. Switch valve
   d. Relief valve.

Answers:

1. a
2. b
3. a

Practical Application:

Check the air pump. The air pump is of the positive displacement, vane type. A belt, V type or ribbed, drives the pump rotor causing the vanes to rotate in the housing. Carbon shoes and springs in the rotor keep vanes aligned and permit a sliding movement between the vanes and rotor. The vanes pass very close to the housing to limit air leakage. From the pump, the air flows through the diverter valve. The check valve is forced off its seat by pump air pressure thus allowing the air to enter the distribution manifold.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 45 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 45 EVALUATION:

PERFORMANCE TEST FOR CHECKING AIR PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly checked pump belt tension.		
2. Checked diverter valve to dump pressure as RPM dropped correctly.		
3. Properly disconnected manifold source vacuum hose from diverter valve and plugged it.		
4. Properly increased engine RPM to listen for diverter valve to dump pressure.		
5. Pinched off air supply hose from diverter valve to air injection manifold correctly.		
6. Properly recorded malfunctions on work chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 46

TASK: Test electronic fuel mixture control system.

STANDARD OF PERFORMANCE OF TASK:

Any deviation from manufacturer's specifications for electronic fuel mixture control system must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special equipment as required by manufacturer

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use special equipment as required by the manufacturer.

RESOURCES:

1. Crouse, et al., **Fuel, Lubricating and Cooling System,** pp. 76-77.

TEACHING ACTIVITIES:

1. Discuss testing oxygen sensor as per manufacturer's procedure and specification.
2. Explain the way to identify an open loop and closed loop voltage to fuel metering valve.
3. Discuss testing individual components.
4. Discuss how to bring the engine to normal operating temperature and increasing engine speed to 2500 RPM for 30 seconds to clear exhaust system. Allow to return to normal idle speed operation.
5. Demonstrate how to hook-up a volt-ohmmeter to fuel metering valve.
6. Show how to close off air slowly for voltage change to verify operation system.
7. Engage students in task and recording test results on work chart.

PERFORMANCE OBJECTIVE 46

CRITERION-REFERENCED MEASURE:

Questions:

1. The exhaust-gas oxygen sensor is called:
   a. Fuel save
   b. Air fuel sensor
   c. Device sensor
   d. Sniffer.
2. The feed back diaphragms operate an idle needle that allows more or less air to bleed into the:
   a. Metering system
   b. Idle system
   c. Mixture system
   d. All of the above.
3. The oxygen sensor sends a ______________________________ to the electronic control unit.
   a. Feed back
   b. Fuel flow
   c. Voltage signal
   d. None of the above.

Answers:

1. d
2. b
3. c

Practical Application:

Test an electronic fuel mixture control system. The oxygen sensor sends a voltage signal to the electronic control unit. The voltage varies as the oxygen in the exhaust gas varies. At the same time the temperature switch is reporting the engine temperature. If the oxygen content of the exhaust gas is low indicating a rich mixture, the ECU signals the vacuum switch and vacuum modulation. They allow vacuum to work the carburetor feedback diaphragm.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 46 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 46 EVALUATION:

PERFORMANCE TEST FOR TESTING ELECTRONIC FUEL MIXTURE CONTROL SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly adjusted volt-ohmmeter.		
2. Tested open/closed loop voltage.		
3. Used manufacturer's procedures correctly.		
4. Properly closed off air slowly and verified voltage change.		
5. Properly increased engine speed to 2500 RPM's for 30 seconds to clear exhaust system.		
6. Recorded test results correctly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING EMISSION CONTROL SYSTEM PROBLEMS

PERFORMANCE OBJECTIVE 47

TASK: Check operation of vacuum operated exhaust manifold heat control valve.

STANDARD OF PERFORMANCE OF TASK:

A failure of the vacuum operated exhaust manifold heat control valve to remain closed with a cold engine and open with the engine at normal operating temperature must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Read and interpret manufacturer's specifications.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair**, p. 848.

TEACHING ACTIVITIES:

1. Discuss the characteristics of cold engine start.
2. Show how to visually check the valve in closed position.
3. Discuss when to run the engine to gain normal temperature.
4. Explain how to check valve in an open position.
5. Engage students in task and record results on chart.

PERFORMANCE OBJECTIVE 47

CRITERION-REFERENCED MEASURE:

Questions:

1. A thermal vacuum switch is used to apply enough engine vacuum to match engine:
   a. Fuel supply
   b. Heat control
   c. Thermal vacuum
   d. Temperature.
2. When engine is cold, ________________ ______________________ is applied.
   a. Engine vacuum
   b. No vacuum
   c. Full vacuum
   d. Vacuum signal.
3. The heat control valve must be checked:
   a. Periodically
   b. On tune-up
   c. Yearly
   d. By dealer.

Answers:

1. d
2. c
3. a

Practical Application:

Check the operation of a vacuum operated exhaust manifold heat control valve. A vacuum motor operated heat control valve is controlled with a thermal vacuum switch that is used to apply enough engine vacuum to match engine temperature. When the engine is cold, full vacuum is applied. As the engine warms, the vacuum signals weaken. When the engine reaches operating temperature, no vacuum is applied. The valve is kept open by spring pressure.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 47 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 47 EVALUATION:

PERFORMANCE TEST FOR CHECKING OPERATION OF VACUUM OPERATED EXHAUST MANIFOLD HEAT CONTROL VALVE

Student's Name Date

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly checked vacuum at valve.		
2. Used vacuum gauge correctly.		
3. Properly checked heat control valve in closed position.		
4. Properly checked heat control valve in open position.		
5. Recorded all malfunction on work chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DIAGNOSING ELECTRONIC CONTROL SYSTEM

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 48

TASK: Test electronic control unit and wiring harness.

STANDARD OF PERFORMANCE OF TASK:

Any malfunctions or defects in the electronic control unit or wiring harness must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Service manual
Volt-ohmmeter
Electronic control unit
Wiring harness.

ENABLING OBJECTIVES:

1. Use a service manual.
2. Use a volt-ohmmeter.
3. Use an electronic control unit and wiring harness.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** p. 391.

TEACHING ACTIVITIES:

1. Explain the proper use of service manual and test procedures.
2. Explain how to make voltage resistance reading change with ignition key on or off.
3. Discuss how to compare reading with service manual specification.
4. Explain the proper way to check all connectors for open circuits.
5. Demonstrate proper way to check wiring for bare wire spots, breaks or shorts.
6. Engage student in task and record results on work chart.

PERFORMANCE OBJECTIVE 48

CRITERION-REFERENCED MEASURE:

Questions:

1. The electronic control unit receives signals from:
    a. Energizer
    b. Control unit
    c. Sensors
    d. Battery.
2. The electronic control is in the form of a:
    a. Preprogrammed computer
    b. Standard computer
    c. Offset computer
    d. Full line computer.
3. The control unit is connected to the system by:
    a. Sensors
    b. Wiring
    c. Sensor monitor
    d. All of the above.

Answers:

1. c
2. a
3. b

Practical Application:

Test electronic control unit and wiring harness. The electronic control is in the form of a preprogrammed computer. Size and complexity varies, depending upon the system. It is usually located in a protected area away from excessive heat. The control unit is connected to the system by means of a wiring harness. The electronic control unit constantly receives signals from a number of sensors. From this input, the control unit evaluates engine fuel needs and adjusts injector pulse accordingly. The control also energizes the fuel pumps.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 48 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 48 EVALUATION:

PERFORMANCE TEST FOR TESTING ELECTRONIC CONTROL UNIT AND WIRING HARNESS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly used service manual.		
2. Used volt-ohmmeter to check resistance properly.		
3. Checked all connectors for open circuits properly.		
4.. Inspected wiring for bare spots, breaks or shorts.		
5. Recorded all readings properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 49

TASK: Test electronic pick-up device.

STANDARD OF PERFORMANCE OF TASK:

Resistance of pick-up device must be within range specified by manufacturer.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Electronic pick-up device
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use an electronic pick-up device.
3. Volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Automotive Engine,** pp. 214-217.

TEACHING ACTIVITIES:

1. Discuss the characteristics of an electronic pick-up device.
2. Explain the purpose of the pick-up device.
3. Explain manufacturer's specifications.
4. Discuss how to air gap adjustment.
5. Explain why the volt-ohmmeter will be used to measure resistance.
6. Discuss the different types of pick-up device.
7. Engage students in task and record findings on work chart.

PERFORMANCE OBJECTIVE 49

CRITERION-REFERENCED MEASURE:

Questions:

1. A electronic pick-up device is a:
    a. Switch
    b. Sensor
    c. Spark
    d. Shield.
2. The reading on the volt-ohmmeter, when attached to pick-up device, is known as:
    a. Resistance
    b. Voltage
    c. Circuit
    d. Current flow.
3. When checking the air gap you must use a:
    a. Magnetic gauge
    b. Medal gauge
    c. Plastic gauge
    d. None of the above.

Answers:

1. b
2. a
3. c

Practical Application:

Test electronic pick-up device. All of the electronic ignition systems are very similar in operation. A sensing device senses the rotation of a trigger wheel, armature or timer core. The sensing device sends voltage pulses to the electronic module. These pulses close and open the battery-to-coil circuit (just like the points in the contact point system). This causes the coil to produce the high voltage surges which make the spark at the spark plug. This system provides timing and advance control solely through the use of sensors (pick-up device) and air electronic computer.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 49 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 49 EVALUATION:

PERFORMANCE TEST FOR TESTING ELECTRONIC PICK-UP DEVICE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly disconnected electronic pick-up device lead.		
2. Checked open circuits with volt-ohmmeter correctly.		
3. Properly measured resistance of electronic pick-up device.		
4. Used reading of resistance to compare with manufacturer's specifications.		
5. Properly used plastic gauge to check air gap.		
6. Properly adjusted air gap.		
7. Recorded all readings on work chart correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 50

TASK: Test exhaust oxygen sensor.

STANDARD OF PERFORMANCE OF TASK:

Failure of the exhaust oxygen sensor to meet manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Vacuum gauge
Manufacturer's service manual

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a vacuum gauge.
3. Read and interpret manufacturer's service manual.

RESOURCES:

1. Crouse, et al., **Automotive Engine**, p. 275.

TEACHING ACTIVITIES:

1. Explain the reason for exhaust oxygen sensor.
2. Discuss different manufacturer's types.
3. Explain the reasons for testing sensor.
4. Explain the reasons for checking engine vacuum.
5. Discuss why it is important to change sensor when faulty.
6. Explain the value of ensuring proper recording of test results.
7. Engage students in performing the task.

PERFORMANCE OBJECTIVE 50

CRITERION-REFERENCED MEASURE:

Questions:

1. The exhaust oxygen provides:
   a. Information to mechanic
   b. Exhaust gases
   c. Voltage that varies
   d. Temperature control.
2. If the oxygen content of the exhaust gas is low, it is indicating:
   a. Vacuum in system
   b. ECU signal
   c. Low mixture
   d. Rich mixture.
3. The oxygen sensor sends signals to the ____________________ on G.M. automobiles:
   a. Driver
   b. Mechanic
   c. Solenoid
   d. ECU.

Answers:

1. c
2. d
3. d

Practical Application:

Test exhaust oxygen sensor. The General Motors Electronic Control System includes an exhaust-gas oxygen sensor (or sniffer). The oxygen sensor provides a voltage that varies as the oxygen in the exhaust gas varies. It sends this voltage signal to the electronic control unit. At the same time, the temperature switch is reporting the engine temperature. If the oxygen content of the exhaust gas is low, indicating a rich mixture, the ECU signals the vacuum switch and vacuum modulator. They allow the vacuum to work the carburetor feedback diaphragms.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 50 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 50 EVALUATION:

PERFORMANCE TEST FOR TESTING EXHAUST OXYGEN SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly started engine and allowed it to warm up.		
2. Connected test equipment correctly.		
3. Used manufacturer's specifications properly.		
4. Properly disconnected oxygen wire and used jump wire from battery to sensor.		
5. Observed change in engine vacuum.		
6. Properly diagnosed oxygen sensor.		
7. Recorded test results correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 51

TASK: Test spark and timing control module.

STANDARD OF PERFORMANCE OF TASK:

Any deviations of resistance or voltage readings from manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter
Spark timing control module

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.
3. Use a spark timing control module.

RESOURCES:

1. Stockel, et al., **Auto Repair and Services,** pp. 450-451.

TEACHING ACTIVITIES:

1. Explain how to identify the spark and timing control module.
2. Discuss the purpose of the unit.
3. Explain the importance of manufacturer's specifications.
4. Explain testing procedures and codes, voltages, and resistances as specified in manual.
5. Engage students in test procedures and record the findings on work chart.

PERFORMANCE OBJECTIVE 51

CRITERION-REFERENCED MEASURE:

Questions:

1. The module computes the incoming signals. It then directs the ignition module to provide:
    a. More or less fuel
    b. More or less RPM
    c. More or less spark advance
    d. All of the above.
2. The electronic ignition system control module receives input from ________________ engine sensors.
    a. 27
    b. 17
    c. 7
    d. None
3. Before testing the spark timing control module you need to have:
    a. Program schedule
    b. Run pick-up
    c. Codes, voltage, resistance
    d. All of the above.

Answers:

1. c
2. c
3. c

Practical Application:

Test spark and timing control module. The electronic ignition system control module receives input from seven engine sensors: coolant temperature, throttle position, carburetor switch, vacuum, start pick-up, run pick-up, and air temperature. Electrical signals from the seven sensors are constantly fed to the computer program schedule mode. The module computes the incoming singles. It then directs the ignition module to provide more or less spark advance. This is a constant process that only takes milliseconds.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 51 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 51 EVALUATION:

PERFORMANCE TEST FOR TESTING SPARK AND TIMING CONTROL MODULE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly disconnected all sensor wiring from module.		
2. Connected module to tester correctly.		
3. Properly set tester as outlined in specified procedures.		
4. Read coded voltage and resistance as specified correctly.		
5. Recorded all readings correctly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 52

TASK: Test barometric pressure sensor.

STANDARD OF PERFORMANCE OF TASK:

Sensor output which is outside of limits established in manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a volt-ohmmeter.
2. Use a standard tool kit.

RESOURCES:

1. Stockel, et al., **Auto Repair and Service,** pp. 390-393.

TEACHING ACTIVITIES:

1. Explain the use of volt-ohmmeter.
2. Discuss the purpose of barometric pressure sensor.
3. Explain test procedures as outlined in service manual.
4. Discuss the importance of a correct pressure sensor output at the altitude where the test is being conducted.
5. Engage students in performing the task and recording results on a work chart.

PERFORMANCE OBJECTIVE 52

CRITERION-REFERENCED MEASURE:

Questions:

1. The barometric pressure sensor sends signals to:
   a. Fuel injectors
   b. Speed control
   c. ECM
   d. EEE.
2. The sensor must be tested for correct output as outlined in:
   a. Service manual
   b. Manufacturer's specifications
   c. Maintenance chart
   d. None of the above.
3. The volt-ohmmeter is connected to the sensor circuit as:
   a. Voltmeter
   b. Diverter
   c. Metering valve
   d. Specified.

Answers:

1. c
2 b
3. d

Practical Application:

Test barometric pressure sensor. The barometric pressure sensor provides information to the ECM on atmospheric pressure changes. The ECM adjust the air/fuel mixture in response to this information.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 52 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 52 EVALUATION:

PERFORMANCE TEST FOR TESTING BAROMETRIC PRESSURE SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly connected volt-ohmmeter.		
2. Properly checked sensor output.		
3. Recorded reading from manufacturer's specifications manual correctly.		
4. Properly observed ECM results.		
5. Properly recorded results on work chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 53

TASK: Test manifold absolute-pressure sensor.

STANDARD OF PERFORMANCE OF TASK:

Deviation of the sensor output voltage or resistance from specified range must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tachometer
Service manual
Vacuum gauge
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a tachometer, vacuum gauge and volt-ohmmeter.
3. Read and interpret service manual.

RESOURCES:

1. Stockel, et al., **Auto Service and Repair,** pp. 392-393.

TEACHING ACTIVITIES:

1. Discuss the purpose of manifold pressure sensor.
2. Explain how the sensor converts pressure into an electronic signal.
3. Discuss vacuum increase/decrease.
4. Explain the atmospheric pressure in manifold.
5. Engage students in performing the task.

PERFORMANCE OBJECTIVE 53

CRITERION-REFERENCED MEASURE:

Questions:

1. The manifold pressure sensor converts pressure into:
    a. Signals
    b. Temperature
    c. Thermal
    d. Injector flow.
2. Evacuated bellows expand as manifold vacuum:
    a. Increases
    b. Decreases
    c. Is transferred
    d. Gas to other manifold.
3. The resistance of the sensor is checked by:
    a. RPM speed
    b. Ohmmeter
    c. Voltmeter
    d. Out-put tachometer.

Answers:

1. a
2. b
3. b

Practical Application:

Test manifold absolute pressure sensor. The manifold pressure sensor converts manifold pressure into electronic signal by means of a sliding armature moving inside transformer coil. The armature is balanced by spring pressure forcing the armature to the right. Atmospheric pressure exists on the right side of diaphragm, while manifold pressure exists on the left side.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 53 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 53 EVALUATION:

PERFORMANCE TEST FOR TESTING MANIFOLD ABSOLUTE PRESSURE SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Properly recorded specific procedures.		
2. Connected tachometer to engine and volt-ohmmeter to sensor correctly.		
3. Properly set engine at high RPM idle.		
4. Correctly recorded vacuum and voltage and resistance of sensor.		
5. Recorded results on work chart properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 54

TASK: Test ambient air temperature sensor.

STANDARD OF PERFORMANCE OF TASK:

Failure of the ambient air temperature sensor to operate at upper and lower temperature limits must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Automotive Fuel, Lubricating and Cooling System,** p. 226.

TEACHING ACTIVITIES:

1. Explain the correct procedure for removing sensor from mounting.
2. Discuss connecting volt-ohmmeter leads to terminals on switch.
3. Explain the importance of a warning switch, when switch temperature is greater than 65 degrees F.
4. Discuss the value of a cooling switch with ice water at 49 degrees F.
5. Demonstrate volt-ohmmeter reading in circuit.

PERFORMANCE OBJECTIVE 54

CRITERION-REFERENCED MEASURE:

Questions:

1. When ambient air temperature sensor fails, you should:
   a. Check with voltmeter
   b. Check temperature
   c. Replace
   d. Check terminals.
2. The air temperature sensor can be tested by:
   a. Heat and water
   b. Resistance and water
   c. Heat and ice water
   d. All of the above.
3. When testing the air temperature sensor, you should have:
   a. Volt-ohmmeter
   b. Manufacturer's specifications
   c. Heat and ice water
   d. All of the above.

Answers:

1. c
2. c
3. b

Practical Application:

Test ambient air temperature sensor. The air temperature sensor provides the ECU with the same type of signals as does the coolant sensor. However, its influence on pulse width is not nearly as great. A shorted air temperature sensor can cause a rich idle. The air temperature sensor can be checked with the fuel- injection analyzer.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 54 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 54 EVALUATION:

PERFORMANCE TEST FOR TESTING AMBIENT AIR TEMPERATURE SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed manufacturer's specification.		
2. Connected volt-ohmmeter correctly.		
3. Properly disconnected sensor terminals.		
4. Properly cooled and warmed sensor for test.		
5. Recorded test results on work chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 55

TASK: Check coolant temperature sensor.

STANDARD OF PERFORMANCE OF TASK:

Check coolant temperature sensor.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Automotive, Fuel, Lubricating and Cooling System,** p. 226.

TEACHING ACTIVITIES:

1. Explain the hook-up of volt-ohmmeter to ground and sensor terminal.
2. Explain the relationship of a continuity test on the sensor with engine cold.
3. Tell the value of pre-inspecting the engine prior to starting engine and warming engine up.
4. Explain the process of engine warm up and sensor opening when engine reaches operating temperature.
5. Engage students in performing the task and recording results.

PERFORMANCE OBJECTIVE 55

CRITERION-REFERENCED MEASURE:

Questions:

1. The coolant sensor increases the pulse width only while the engine coolant is below:
   a. 190 F.
   b. 180 F.
   c. 185 F.
   d. 195 F.
2. The resistance of the sensor with the engine cold is:
   a. High
   b. Normal
   c. Low
   d. No reading.
3. When sensor resistance is low, the fuel mixture will be:
   a. Less
   b. Higher than idle
   c. Richer
   d. All of the above.

Answers:

1. b
2. c
3. c

Practical Application:

Check coolant temperature sensor. The coolant sensor increases the pulse width only while the engine coolant is below 180°F (98.2°c.) With a cold engine, the sensor has a low resistance. As coolant temperature increases, so does sensor resistance. Therefore if the sensor resistance is low (shorted) and the engine is warm, the ECU knows only that the resistance is low and will lengthen the pulse width. This action results in richer mixture. The coolant sensor may be tested with the fuel injection analyzer.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 55 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 55 EVALUATION:

PERFORMANCE TEST FOR CHECKING COOLANT TEMPERATURE SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed manufacturer's specification.		
2. Properly hooked-up volt-ohmmeter.		
3. Recorded malfunction on work chart.		
4. Properly started engine for warmup.		
5. Checked for continuity in the sensor with cold engine.		
6. Recorded reading on work chart properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 56

TASK: Test throttle position sensor.

STANDARD OF PERFORMANCE OF TASK:

Any failure of the throttle position sensor to operate within manufacturer's specifications must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Automotive, Fuel, Lubricating and Cooling System,** p. 226.

TEACHING ACTIVITIES:

1. Discuss the measuring of resistance with volt-ohmmeter across sensor.
2. Explain how to connect volt-ohmmeter lead to ground and positive lead to one sensor terminal; repeat 4 or 5 times.
3. Demonstrate moving throttle linkage from full open to full close.
4. Show the students how to observe volt-ohmmeter reading and compare reading with manufacturer's specifications.
5. Engage the students in performing the task and recording findings on the work chart.

PERFORMANCE OBJECTIVE 56

CRITERION-REFERENCED MEASURE:

Questions:

1. One function of the sensor is to:
    a. Short out signal
    b. Return signal to unit
    c. Provide signal to ECU
    d. Provide signal to ECM.
2. Testing of the WOT circuit is accomplished with the fuel injection:
    a. Vacuum
    b. Fuel supply
    c. Dwell meter
    d. Analyzer.
3. If the WOT section of the throttle position switch is shorted it will provide:
    a. Unload signal
    b. No start signal
    c. Flood engine
    d. Wide open throttle.

Answers:

1. c
2. d
3. a

Practical Application:

Test throttle position sensor. One of the functions of the throttle position sensor is to provide a signal for the ECU, when wide open throttle is reached. However this signal is also used to perform another function. While the possibility of a flooded engine is remote with EFI, the possibility does exist. So just as with carburetors, a means of clearing a flooded engine is incorporated. If the throttle is held open, the throttle position provides a wide open throttle (WOT) signal. If the ECU receives this signal along with cranking signal, it stops pulsing the injector.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 56 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 56 EVALUATION:

PERFORMANCE TEST FOR TESTING THROTTLE POSITION SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed manufacturer's specifications.		
2. Properly disconnected sensor.		
3. Measured resistance correctly.		
4. Properly reconnected sensor wire with ignition key to run position.		
5. Moved throttle linkage from "full open" to "full closed" properly.		
6. Repeated steps 4 and 5 with other sensor wire correctly.		
7. Recorded all resistance correctly.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 57

TASK: Test engine speed sensor.

STANDARD OF PERFORMANCE OF TASK:

Any deviation of engine speed sensor output at specified engine speed must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Service manual
Volt-ohmmeter
Tachometer.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Read and interpret service manual.
3. Use volt-ohmmeter and tachometer.

RESOURCES:

1. Crouse, et al., **Automotive, Fuel, Lubricating and Cooling System,** p. 225.

TEACHING ACTIVITIES:

1. Discuss the specifications in the service manual.
2. Explain the correct hook-up for tachometer and volt-ohmmeter to sensor.
3. Explain how to start the engine by using fast idle cam, as specified in manual.
4. Discuss how to read voltage and resistance of sensor as specified in the manual.
5. Engage students in performing the task and recording readings on the work chart.

PERFORMANCE OBJECTIVE 57

CRITERION-REFERENCED MEASURE:

Questions:

1. The fuel supply will be cut off if the speed sensor sends a:
    a. No signal
    b. Positive signal
    c. An open signal
    d. A and c.
2. The speed sensor can be checked by a:
    a. Volt-meter
    b. Ohmmeter
    c. Analyzer
    d. Trouble light.
3. The unit that interprets the speed sensor is:
    a. ECU
    b. ECM
    c. Analyzer
    d. EGR.

Answers:

1. d
2. c
3. a.

Practical Application:

Test engine speed sensor. When there is no signal from the speed sensor, the ECU will interpret it as an engine-off signal and will normally shut off fuel pumps. Speed sensor operation may be checked using the analyzer. If the sensor checks good on the analyzer, the possibility still exists that an intermittent problem may be occurring. Operate the engine with the analyzer in monitor position. Watch the trigger point lights as the stall develops. If the light operates properly until the engine stalls, crank the engine immediately and observe the speed sensor light.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 57 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 57 EVALUATION:

PERFORMANCE TEST FOR TESTING ENGINE SPEED SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed service manual specifications.		
2. Used volt-ohmmeter and tachometer properly.		
3. Operated analyzer correctly.		
4. Started and set engine on fast idle cam properly.		
5. Recorded reading on work chart from service manual and diagnosis.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 58

TASK: Test road speed sensor.

STANDARD OF PERFORMANCE OF TASK:

Any deviation from manufacturer's specifications for resistance in the sensor must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.

RESOURCES:

1. Crouse, et al., **Automotive, Fuel, Lubricating and Cooling System,** p. 226.

TEACHING ACTIVITIES:

1. Show how to properly hook-up volt-ohmmeter.
2. Explain the purpose of speed sensor.
3. Discuss manufacturer's specifications.
4. Discuss proper way to disconnect and connect wiring on speed sensor.
5. Explain why resistance between sensor case and each terminal is to be checked as outlined in the service manual.
6. Engage students in the task and discuss results with them.

PERFORMANCE OBJECTIVE 58

CRITERION-REFERENCED MEASURE:

Questions:

1. The speed sensor consists of:
   - a. Injector switch
   - b. Two switches
   - c. Pump switch
   - d. Pressure.
2. The trigger point 1 light should blink on at essentially the same as the:
   - a. Injector group 1 light
   - b. Pump group 1 light
   - c. ECU group 1 light
   - d. All of the above.
3. The ECU will pulse the injector:
   - a. Engine will not run,
   - b. Sensor will not operate,
   - c. Not proper length of time,
   - d. None of the above.

Answers:

1. b
2. a
3. c

Practical Application:

Test road speed sensor. The speed sensor consists of a pair of switches that tell the ECU when to activate the injector group and which injector group should be activated. If either of the switches does not close properly, then the ECU will not pulse any injector.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 58 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 58 EVALUATION:

PERFORMANCE TEST FOR TESTING ROAD SPEED SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed specifications for speed sensor resistances.		
2. Disconnected the speed sensor wiring connector properly.		
3. Compared resistance with manufacturer's specifications.		
4. Properly checked speed sensor case with each terminal.		
5. Reconnected all wiring correctly and recorded the results on work chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY; DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 59

TASK: Test neutral/park position sensor.

STANDARD OF PERFORMANCE OF TASK:

Output of neutral/park position sensor deviating from the values specified by the manufacturer when gear selector is shifted through all positions must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Service manual
Volt-ohmmeter

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Read and interpret service manual.
3. Use a volt-ohmmeter.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** p. 608.

TEACHING ACTIVITIES:

1. Explain the purpose of the neutral/park sensor.
2. Show the location of the sensor.
3. Explain the proper method of checking sensor with volt-ohmmeter.
4. Discuss manufacturer's specification in using the sensor.
5. Engage students in task and have them record results.

PERFORMANCE OBJECTIVE 59

CRITERION-REFERENCED MEASURE:

Questions:

1. The neutral park sensor is used for:
   a. Transmission brake
   b. Selector control assembly
   c. Shifting through gears
   d. Cranking engine.
2. When sensor is non-operational it will allow the engine to start in:
   a. Neutral
   b. Park
   c. Reverse
   d. None of the above.
3. The sensor for the auto could be located in the:
   a. Transmission
   b. Steering column
   c. Console
   d. All of the above.

Answers:

1. d
2. d
3. d

Practical Application:

Test neutral/park position sensor. When checking the operation of the neutral/park safety starting switch for proper operation, the engine should crank with the selector level in either the neutral or park position. The engine should not crank with the selector lever in any other position. You should adjust or replace the safety switch as needed. The switch may be located on the steering column, on the floor shift console or on the transmission itself.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 59 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 59 EVALUATION:

PERFORMANCE TEST FOR TESTING NEUTRAL/PARK POSITION SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed manufacturer's specification.		
2. Properly checked sensor with volt-ohmmeter.		
3. Properly set parking brake and shifted gears through positions.		
4. Properly compared volt-ohmmeter reading in park and neutral with manufacturer's specifications.		
5. Recorded results correctly on work chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: DIAGNOSING ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 60

TASK: Test anti-detonation sensor.

STANDARD OF PERFORMANCE OF TASK:

Any failure of the anti-detonation sensor to retard the timing in accordance with manufacturer's cautions must be detected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Adjustable timing light.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a volt-ohmmeter.
3. Use a service manual.

RESOURCES:

1. Stockel, et al., **Auto Service Repair**, pp. 868-869.

TEACHING ACTIVITIES:

1. Discuss the proper way to connect adjustable timing light to engine.
2. Explain the reason for idling engine at 1200 RPM's.
3. Explain the reason for tapping lightly on intake manifold.
4. Explain the purpose in reducing timing while tapping on intake manifold.
5. Discuss how to record results found during testing procedures.

PERFORMANCE OBJECTIVE 60

CRITERION-REFERENCED MEASURE:

Questions:

1. Tapping on the __________ will change the engine timing:
   a. Exhaust manifold
   b. Catalytic convertor
   c. Intake manifold
   d. Oxygen sensor
2. The detonation sensor is located in the:
   a. Cylinder head
   b. Exhaust
   c. Intake
   d. None of the above.
3. The proper type of timing light used in testing the detonation sensor is:
   a. Standard
   b. Machine type
   c. Non-Electrical
   d. Adjustable.

Answers:

1. c
2. c
3. d

Practical Application:

Test anti-detonation sensor. The control unit (computer) receives constant electric signals from the oxygen sensor. Based on the information from the sensor, and other sensors (engine timing, temperature, car speed, engine RPMS and atmospheric pressure), the computer makes changes in the air-fuel mixture, engine timing, EGR. and other functions. By tapping on the intake manifold lightly, the anti-detonation sensor reduces the advance timing and will indicate that the anti-detonation sensor is operating correctly.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 60 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 60 EVALUATION:

PERFORMANCE TEST FOR TESTING ANTI-DETONATION SENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly hooked-up timing light.		
2. Properly adjusted timing light.		
3. Used small wrench to tap on intake manifold as instructed.		
4. Properly adjusted idle screw to obtain engine speed at 1200 RPM's.		
5. Properly recorded reading on work chart.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

MAINTAINING THE IGNITION

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 61

TASK: Adjust dwell of contact points.

STANDARD OF PERFORMANCE OF TASK:

Contact points adjustment must be secure (if appropriate) and dwell reading in degrees and/or contact point gap must be within manufacturer's specified range.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Dwell meter or engine tune-up analyzer
List of manufacturer's specifications
Feeler gauge set

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a dwell meter or engine tune-up analyzer.
3. Use a feeler gauge.
4. Read and interpret manufacturer's specifications.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** p. 431.

TEACHING ACTIVITIES:

1. Explain how contact point ignition system works.
2. Describe the action in each of the two basic circuits in ignition system.
3. Explain the process of dwell setting.
4. Discuss manufacturer's specification.
5. Explain how to vacuum advance system.
6. Engage students in task and have them record finding on work chart.

PERFORMANCE OBJECTIVE 61

CRITERION-REFERENCED MEASURE:

Questions:

1. While setting the dwell on a 6 cylinder engine, you need to remove the:
   a. Rotor
   b. Primary wire
   c. Vacuum line
   d. All of the above.
2. The point gap will measure out in:
   a. Thousands
   b. Hundreds
   c. Degrees
   d. A and c.
3. Points should be inspected at each:
   a. 10,000 miles
   b. When needed
   c. Tune-up
   d. All of the above.

Answers:

1. c
2. d
3. c

Practical Application:

Adjust dwell of contact points. The dwell, often called cam angle, refers to the number of degrees the distributor cam turns from the time the points close until they open again. The dwell for any given cam is controlled by the point gap so the two must be considered together. If point adjustments falls to give the specified dwell, the cam may be worn.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 61 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 61 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING DWELL OF CONTACT POINTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used manufacturer's specifications.		
2. Adjusted dwell meter correctly.		
3. Removed vacuum and plugged vacuum line.		
4. Connected electrical wire correctly on coil and battery from dwell meter.		
5. Loosened contact point and made adjustment properly.		
6. Reinstalled all components to gain access to points correctly.		
7. Recorded all reading on work chart properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 62

TASK: R and R distributor cap.

STANDARD OF PERFORMANCE OF TASK:

The distributor cap must be secure and the secondary wires must be in correct receptacles and secure.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Read and interpret manufacturer's specifications.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** p. 425.

TEACHING ACTIVITIES:

1. Discuss removal process to gain access to the distributor.
2. Explain the proper method of removing distributor cap from distributor.
3. Demonstrate how to install a new distributor cap.
4. Explain the steps in removing secondary wire in old cap and installing wire in new cap.
5. Explain the necessity of verifying that secondary wires are installed in correct firing order.
6. Demonstrate the steps in reinstalling component parts.
7. Engage students in task and have them record results on work chart..

PERFORMANCE OBJECTIVE 62

CRITERION-REFERENCED MEASURE:

Questions:

1. When installing a new distributor cap you should:
   - a. Pull wire from old cap,
   - b. Remove components part,
   - c. Check timing mark,
   - d. All of the above
2. When you have new cap mounted on the distributor, you:
   - a. Install secondary wires,
   - b. Install motor,
   - c. Check timing mark,
   - d. Install components.
3. A distributor cap requires replacement when:
   - a. Terminal post badly grooved,
   - b. Rough cam surface,
   - c. Short rubbing block,
   - d. Coated surface.

Answers:

1. b
2. a
3. a

Practical Application:

R and R a distributor cap. In replacing a distributor cap, you first remove the component parts on the engine to gain access to the distributor, then remove each distributor cap wire from their tower. Inspect the tower for signs of corrosion, burning or flashover. Mild corrosion may be removed with a special wire brush, or sand paper. Replace the cap if flashover has been present. When replacing each wire, make sure the terminal is clean and is shoved into the tower to the full depth.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 62 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 62 EVALUATION:

PERFORMANCE TEST FOR R AND R DISTRIBUTOR CAP

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed component part to gain access to distributor cap properly.		
2. Removed tower wire properly.		
3. Removed cap from distributor and inspected for cracks, corrosion, burns and flashover properly.		
4. Replaced new cap and wire correctly.		
5. Replaced component parts properly.		
6. Recorded findings on work chart correctly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 63

TASK: R and R distributor rotor.

STANDARD OF PERFORMANCE OF TASK:

The rotor must be indexed and secured and the distributor cap must be secured.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement rotor.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Install new rotor.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** p. 426.

TEACHING ACTIVITIES:

1. Discuss the different types of rotors.
2. Explain the purpose of rotor.
3. Discuss the importance of inspecting the rotor for damage or burns.
4. Explain how to install a new rotor.
5. Engage students in task and have them record findings on a work chart.

PERFORMANCE OBJECTIVE 63

CRITERION-REFERENCED MEASURE:

Questions:

1. When replacing some electronic ignition system rotors, you should:
   a. Clean rotor
   b. File lip
   c. Use oil tip
   d. Use silicone on tip.
2. Two type rotors are:
   a. Triple tip/with no contact spring,
   b. No tip/4 tip,
   c. Multipoint/blade tip,
   d. Electronic/compound.
3. A rotor that is carelessly installed can either:
   a. Make engine miss
   b. Offset timing
   c. Damage itself
   d. Damage itself, cap or both.

Answers:

1. d
2. c
3. d

Practical Application:

R and R a distributor rotor. Rotors are removed by grasping and pulling straight up. Another type distributor uses a rotor that is held in place by screws. When installing a rotor, make certain it is aligned with the flat on the distributor shaft and that it is pressed down fully. A rotor that is carelessly installed can either damage the distributor cap, itself or both.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 63 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 63 EVALUATION:

PERFORMANCE TEST FOR R AND R DISTRIBUTOR ROTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed distributor cap properly.		
2. Removed rotor correctly.		
3. Inspected rotor properly.		
4. Selected correct rotor for replacement.		
5. Replaced rotor properly.		
6. Replaced distributor cap correctly.		
7. Started engine and checked for proper engine performance.		
8. Recorded procedures on work chart properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 64

TASK: R and R contact points.

STANDARD OF PERFORMANCE OF TASK:

The contact points must be adjusted according to manufacturer's procedures and secure and the degrees of dwell angle must be within manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement points.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Properly identify replacement points.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** p. 427.

TEACHING ACTIVITIES:

1. Discuss the purpose of contact points.
2. Explain the operation of contact points.
3. Discuss the causes for replacement of points.
4. Demonstrate how to lubricate the rubbing block of points.
5. Explain correct way to set contact points.
6. Engage students in the proper installation and setting of contact points.

PERFORMANCE OBJECTIVE 64

CRITERION-REFERENCED MEASURE:

Questions:

1. Contact points should be replaced when:
    a. Gray in color
    b. Red in color
    c. Eroded
    d. Lack of color.
2. When you file a set of contact points you should:
    a. Put in vice
    b. Use sand paper
    c. Use file
    d. Do not file.
3. When you inspect contact points you should check:
    a. Cam lubricant
    b. Oil free
    c. Smooth for proper breaking
    d. All of the above.

Answers:

1. c
2. d
3. b

Practical Application:

R and R contact points. When inspecting the contact point set for service, separate the breaker points and check point condition. A dull, slate gray color is normal. The points will need to be replaced if burned badly, eroded, excessively pitted or metal is present. Do not attempt to file away any work. The points must be clean of oil.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 64 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 64 EVALUATION:

PERFORMANCE TEST FOR R AND R CONTACT POINTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly removed distributor cap.		
2. Removed contact points correctly.		
3. Followed inspection of contact point for burns, bad erosion, excessive pitting and oil.		
4. Installed points correctly.		
5. Properly gapped points setting.		
6. Replaced distributor cap properly.		
7. Recorded results on work chart.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 65

TASK: R and R condensor.

STANDARD OF PERFORMANCE OF TASK:

Condensor must be securely mounted; and primary wire must be correctly routed and connected.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement condensor.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a replacement condensor.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** p. 429.

TEACHING ACTIVITIES:

1. Discuss the purpose of condensor.
2. Explain the reason for checking capacity, resistance and leakage.
3. Explain why condensor is changed when points are changed.
4. Demonstrate the proper way to install condensor.
5. Engage students in the task and have them record information properly on a work chart.

PERFORMANCE OBJECTIVE 65

CRITERION-REFERENCED MEASURE:

Questions:

1. The condensor should be replaced only when:
   a. Electronic mode fails
   b. Rotors are replaced
   c. Points are replaced
   d. All of the above.
2. A new condensor should be checked for:
   a. Proper size
   b. Works with points
   c. Resistance and leakage
   d. All of the above.
3. When new condensor is installed, it should be checked for:
   a. Breaker flexes
   b. Rubbing block
   c. Angle
   d. Free of moving parts.

Answers:

1, c
2. c
3. d

Practical Application:

R and R condensor. Common practice is to change the condensor when contact points are replaced. If the condensor is not to be changed, it should be checked for capacity, resistance, and leakage. A new condensor should also be checked. A new condensor should be installed firmly and free of moving parts.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 65 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 65 EVALUATION:

PERFORMANCE TEST FOR R AND R CONDENSOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Properly removed distributor cap.		
2. Properly disconnected primary wire to condensor.		
3. Properly removed mounting screw.		
4. Removed condensor properly.		
5. Installed condensor correctly.		
6. Properly connected primary wire.		
7. Replaced distributor cap.		
8. Started and checked engine operation.		
9. Recorded results on work chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 66

TASK: R and R distributor.

STANDARD OF PERFORMANCE OF TASK:

Distributor must be secured and lubricated, and dwell angle and timing must be within manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement distributor
Dwell meter
Timing light
List of manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Read and interpret manufacturer's specifications.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** pp. 433-434.

TEACHING ACTIVITIES:

1. Lecture on the various components of distributor.
2. Describe the characteristics of bushing, shaft, bearing, cam lobe and gear wear.
3. Discuss the requirement for complete overhaul.
4. Describe advance mechanisms.
5. Describe centrifugal advance mechanism.
6. Engage students in the inspection and repair process.
7. Ensure student makes proper recording on work chart.

PERFORMANCE OBJECTIVE 66

CRITERION-REFERENCED MEASURE:

Questions:

1. When you remove the distributor from the engine you should:
    a. Mark location of rotor,
    b. Check distributor cap,
    c. Check point setting,
    d. Check firing order.
2. The distributor should be overhauled when:
    a. Points need setting
    b. Bushings wear
    c. Each tune-up
    d. During annual maintenance.
3. When replacing secondary wire in distributor cap you should:
    a. Remove all wire from cap,
    b. Verify correct firing order,
    c. Check old cap,
    d. Check dwell reading.

Answers:

1. a
2. b
3. b

Practical Application:

R and R a distributor. The distributor must be overhauled when the bushing shaft, gear or cam wear becomes excessive or when the advance mechanisms fail to function correctly. Before removing the gear from the shaft, measure from the top of the gear to some reference point on the distributor housing and pull shaft.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 66 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 66 EVALUATION:

PERFORMANCE TEST FOR R AND R DISTRIBUTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Removed distributor cap correctly.		
2. Marked rotor properly.		
3. Removed lock on distributor properly.		
4. Properly inspected shaft, cam and bushing.		
5. Replaced all worn parts properly.		
6. Installed distributor and adjusted timing correctly.		
7. Recorded results on work chart properly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 67

TASK: R and R spark advance/retard assembly.

STANDARD OF PERFORMANCE OF TASK:

The spark advance/retard assembly must be mounted and secured with linkages and hoses connected according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement spark advance/retard assembly
Hand-held vacuum pump
Timing equipment.

ENABLING OBJECTIVE:

1. Use a standard tool kit.
2. Use a hand-held vacuum pump.
3. Use timing equipment.
4. Identify the process of spark advance/retard assembly.

RESOURCES:

1. Stockel, et al., **Automotive Service and Repair,** pp. 435-437.

TEACHING ACTIVITIES:

1. Explain the purpose of spark advance/retard assembly.
2. Discuss the proper testing of advance/retard assembly.
3. Discuss the value of quick testing of vacuum advance.
4. Explain how to properly use hand held vacuum pump.
5. Discuss the process of proper removal of vacuum advance.
6. Demonstrate the proper way to install vacuum advance.
7. Engage students in the testing and replacement process and record all information on work chart.

PERFORMANCE OBJECTIVE 67

CRITERION-REFERENCED MEASURE:

Questions:

1. When checking a vacuum advance with the engine running you need:
   a. Vacuum hand pump
   b. Centrifugal vacuum gauge
   c. Timing light
   d. Dwell meter.
2. When checking the non-operation vacuum advance you need to check:
   a. Breaker plate
   b. Timing mark pointer
   c. Timing mark
   d. Secondary spring.
3. The hand-held vacuum pump can be used to apply:
   a. Release of diaphragm
   b. Smoothness of diaphragm
   c. Controlled vacuum
   d. All of the above.

Answers:

1. c
2. a
3. c

Practical Application:

R and R spark advance/retard assembly. While testing the vacuum advance/retard assembly, disconnect the vacuum advance line from vacuum source. Connect timing light, and start engine and run steadily at a 1,200 RPM. Check position of timing mark to timing pointer. Then connect vacuum line to advance unit. The timing mark should immediately move against the direction of the engine rotation (advance). If the vacuum advance is non-operative, remove distributor and test on distributor machine. A hand-held pump can be used to apply vacuum.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 67 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 67 EVALUATION:

PERFORMANCE TEST FOR R AND R SPARK ADVANCE/RETARD ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Followed instructions for removing necessary components to gain access to distributor.		
2. Removed distributor properly.		
3. Properly checked vacuum advance with hand held vacuum pump.		
4. Installed replacement assembly properly.		
5. Installed distributor properly.		
6. Checked timing mark and pointer with engine running as instructed.		
7. Recorded results on work chart correctly.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 68

TASK: Adjust ignition timing.

STANDARD OF PERFORMANCE OF TASK:

Distributor must be secure and initial timing must be within manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Ignition timing light or magnetic timing equipment.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use an ignition timing light or magnetic timing equipment.

RESOURCES:

Stockel, et al., **Automotive Service and Repair,** p. 436.

TEACHING ACTIVITIES:

1. Discuss the process of ignition timing.
2. Demonstrate the correct hook-up for timing light.
3. Explain the reason for disconnecting and plugging vacuum hose at distributor.
4. Schematically turn the location of timing mark.
5. Explain the process of loosening distributor lock down bolt.
6. Demonstrate how to rotate the distributor to gain correct timing as outlined in manufacturer's specification.
7. Show how to secure distributor lock down bolt.
8. Engage students in task and have them record results on work chart.

PERFORMANCE OBJECTIVE 68

CRITERION-REFERENCED MEASURE:

Questions:

1. Engine timing is set by:
    a. Turning distributor
    b. Changing wires in distributor
    c. Moving timing belt
    d. All of the above.
2. When timing is required, the correct __________ must be set.
    a. Timing light
    b. Engine RPM
    c. BTDC
    d. ATDC

3. The engine will attempt to run backwards when:
    a. Engine fires too early,
    b. Engine fires late,
    c. RPM setting,
    d. Dwell incorrect.

Answers:

1. a
2. b
3. a

Practical Application:

Adjust ignition timing. The distributor's initial setting (timing mark aligned with pointer or scale, rotor facing number one plug wire tower and points just opening) will suffice for starting engine. Favor a slightly retarded setting (engine attempting to rotate backwards due to the plug being fired too early). If recommended by manufacturer, remove vacuum advance hose and plug. Loosen the distributor clamp and rotate distributor until timing mark and pointer are aligned to manufacturer's specification.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 68 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 68 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING IGNITION TIMING

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Followed instructions on hook-up and use of timing light.		
2. Adjusted distributor as outlined in manufacturer's manual.		
3. Marked timing mark correctly.		
4. Recorded results on work chart correctly.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 69

TASK: R & R ignition coil.

STANDARD OF PERFORMANCE OF TASK:

Ignition coil and its wiring must be secure and in its specified location.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement coil
Coil tester or engine analyzer.

ENABLING OBJECTIVES:

1. Use a standard tool kit.
2. Use a tester or engine analyzer.
3. Use a replacement coil.

RESOURCES:

Stockel, et al., **Auto Service and Repair,** pp.418, 419, 420.

TEACHING ACTIVITIES:

1. Discuss the purpose of coil.
2. Explain the way to properly test procedures.
3. Demonstrate correct method of removing and replacing old coil.
4. Demonstrate the correct method of disconnecting and correcting primary and secondary wires.
5. Show how to transfer a mounting bracket from old to new coil.
6. Explain the purpose of a radio static condensor.
7. Engage students in procedures and have them record results on a work chart.

PERFORMANCE OBJECTIVE 69

CRITERION-REFERENCED MEASURE:

Questions:

1. When removing the coil from the ignition system you first:
   - a. Remove primary wire
   - b. Remove secondary wire
   - c. Turn ignition switch off
   - d. All the above.
2. When removing the primary and secondary wire you should:
   - a. Remove primary first
   - b. Remove secondary first
   - c. Mark primary first
   - d. Remove battery cable.
3. When you replace the coil you need to use:
   - a. Bracket
   - b. Attachment rod
   - c. New primary wire
   - d. All the above.

Answers:

1. c
2. c
3. a

Practical Application:

R & R ignition coil. The coil should be checked for available voltage. The test should be performed after the coil has reached operating temperature. Other checks include testing both primary and secondary circuit resistance, and correct draw during idle when the engine is stopped. These tests usually expose any internal shorts, grounds or open insulation breakdown. Use reliable test equipment and manufacturer's instructions.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 69 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 69 EVALUATION:

PERFORMANCE TEST FOR R & R IGNITION COIL

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Used proper test equipment correctly		
2. Properly checked primary and secondary side of coil.		
3. Followed manufacturers instructions.		
4. Removed old coil correctly.		
5. Installed new coil properly.		
6. Recorded proper remarks on work chart.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 70

TASK: R & R spark plug wires.

STANDARD OF PERFORMANCE OF TASK:

Spark plug wires must be connected, secured and routed according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement set of spark plug wires.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Obtain a replacement set of spark plug wires.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service**, pp. 357-358 and 365-366

TEACHING ACTIVITIES:

1. Have student read and discuss **Auto Mechanics Theory and Service**, pp.357-258 and 365-366
2. Lecture to students on the problems that may occur to spark plug wires and why they need to be replaced.
3. Lecture to students on how to obtain the proper order in which the wires are to be arranged.
4. Demonstrate how to properly remove and replace a set of spark plug wires.
5. Have students complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 70

CRITERION-REFERENCED MEASURE:

Questions:

1. When replacing spark plug wires it is best to:
   a. Remove all of them at once and then replace them.
   b. Remove and replace them one at a time.
   c. Remove them two at a time and then replace.
   d. Remove one end at a time and replace with a new one.
2. When replacing spark plug wire it is best to start with the number ________ cylinder.
3. Firing order is:
   a. The order in which the cylinders receive their electrical impulse,
   b. The order in which the car is turned on,
   c. The same order in which all cars fire.
   d. The order in which the crankshaft rotates.

Answers:

1. b
2. One
3. a

Practical Application:

The student will remove and replace a set of spark plug wires in accordance with manufacturer's specifications with 100 percent accuracy.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 70 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 70 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING SPARK PLUG WIRES

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Made sure ignition switch was off.		
2. Located the spark plug wires.		
3. Removed shields or other components for access to wires as necessary.		
4. Removed one spark plug wire at a time using a wire remover.		
5. Matched old wire with new replacement wire of same length.		
6. Installed new wire on spark plug and distributor cap: Do not sharply bend or twist wires during installation.		
7. Repeated for each wire.		
8. Routed plug wires to original locations.		
9. Checked that all wire guides/looms are installed.		
10. Checked that wires do not touch hot components or sharp or rough edges.		
11. Replaced components removed for access.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 71

TASK: R & R spark plugs.

STANDARD OF PERFORMANCE OF TASK:

Spark plug must be gapped and torqued to manufacturer's specifications with no cross-threading or cracked insulator.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement spark plug
Source of compressed air.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Use compressed air source.

RESOURCES:

deKryger,et al., **Auto Mechanics Theory and Service**, pp. 373-375

TEACHING ACTIVITIES:

1. Students will read and discuss **Auto Mechanics Theory and Service**, pp. 373-375.

2. Lecture to students on the reasons why you would have to replace spark plugs.
3. Explain how to interpret the burn patterns of spark plugs.
4. Demonstrate how to properly cap a spark plug.
5. Demonstrate how to remove and replace a spark plug.
6. Lecture to students on some of the problems that may be encountered while changing plugs.
7. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 71

CRITERION-REFERENCED MEASURE:

Questions:

1. When replacing spark plugs:
    a. Just tighten the plugs hand tight.
    b. Only tighten them with a ratchet wrench.
    c. The spark plugs should always be tightened with a torque wrench.
    d. They don't have to be tightened,they plug in.
2. Spark plugs:
    a. Have a ceramic core and are very fragile
    b. Have a liquid core
    c. Have a steel core
    d. None of the above.
3. The heat range of a spark plug determines;
    a. How much fire goes to the tip
    b. How fast heat is dissipated back through the plug
    c. What type of engine the plug takes
    d. How much heat the plug will take.

Answers:

1. c
2. a
3 b

Practical Application:

Remove and replace a set of spark plugs in accordance with manufacturer's specifications with 100 percent accuracy.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 71 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 71 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING SPARK PLUGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Switched ignition off.		
2. Located spark plug.		
3. Removed spark plug wire connector from plug being careful to free plug wire boot first (Do not pull wire itself).		
4. Selected correct size spark plug socket.		
5. Using compressed air, blew dirt and debris from spark plug mounting area.		
6. Loosened and removed spark plug.		
7. Checked gap of replacement plug to manufacturer's specifications.		
8. Installed spark plug and torque to manufacturer's specifications.		
9. Reconnected spark plug wire.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 72

TASK: Clean spark plug.

STANDARD OF PERFORMANCE OF TASK:

Spark plug must be cleaned of carbon deposits and electrodes filed to proper contour and gap.

SOURCE OF STANDARD:

Writing team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Source of compressed air
Compressed air blow gun
Spark plug cleaner
Carbon scraper
Spark plug contact file
Spark plug gap gauge.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Use spark plug cleaner.
3. Use carbon scraper
4. Use a plug contact file.

RESOURCES:

Toboldt, et al., **Automotive Encyclopedia,** pp. 415-416.

TEACHING ACTIVITIES:

1. Read and discuss **Automotive Encyclopedia,**_pp. 415-416.
2. Lecture to students why you would clean and not replace a spark plug.
3. Demonstrate how to properly clean a spark plug.
4. Lecture on the importance of complete and thorough cleaning.
5. Demonstrate how to properly set a spark plug.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 72

CRITERION-REFERENCED MEASURE:

Questions:

1. When cleaning spark plugs:
    a. It is only necessary to clean the outside of the plug, the inside stays clean.
    b. Only the inside should be cleaned thoroughly.
    c. Gasoline is a good cleaning solution to clean them.
    d. The inside and outside should be sandblasted thoroughly.
2. Carbon deposits on a spark plug:
    a. Will give a path for the spark to follow
    b. Will decrease the gap
    c. Will stop the plug from firing
    d. All of the above.
3. When cleaning spark plugs you must be careful not to do which of the following:
    a. Drop the spark plug
    b. Damage the electrode
    c. Damage the threads
    d. All of the above.

Answers:

1. d
2. d
3. d

Practical Application:

Students will clean and gap a spark plug with the proper contour and gap according to manufacturer's specifications with 100 percent accuracy.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 72 to determine the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 72 EVALUATION:

PERFORMANCE TEST FOR CLEANING SPARK PLUGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Switched ignition off.		
2. Located spark plug.		
3. Removed spark plug wire connector from plug.		
4. Select correct size spark plug socket.		
5. Blew dirt and debris from spark plug mounting area with compressed air.		
6. Loosened and removed spark plug.		
7. Removed heavy carbon deposits with a scraper.		
8. Cleaned plug in a plug cleaner or by manufacturer's procedures.		
9. Filed spark plug electrode to remove rounded edges.		
10. Filed spark plug ground leg to remove pits.		
11. Adjusted spark plug gap to manufacturer's specifications.		
12. Removed any trace of cleaning material with compressed air.		
13. Reinstalled and torqued to manufacturer's specifications.		
14. Reattached spark plug wire to spark plug.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 73

TASK: R & R glow plug.

STANDARD OF PERFORMANCE OF TASK:

Glow plug must be installed according to manufacturer's procedures and specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Glow plug wrench
Replacement glow plug
Source of compressed air
Compressed air blow gun.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Use glow plug wrench.
3. Describe a glow plug.
4. Use compressed air.
5. Use air blow gun.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp.240.

TEACHING ACTIVITIES:

1. Read and discuss **Auto Mechanics Theory and Service,** p. 240.
2. Lecture on the different types of glow plugs.
3. Discuss the safety involved in working around glow plugs.
4. Demonstrate how to remove and replace a glow plug.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 73

CRITERION-REFERENCED MEASURE:

Questions:

1. Glow plugs are:
   - a. Heated by gas
   - b. Heated by diesel fuel
   - c. Heated by mechanical action
   - d. Heated by electricity.
2. Glow Plugs:
   - a. Stay on all the time the engine is running
   - b. Are on only when the engine is cranking
   - c. Are turned on to pre-heat the engine before it starts
   - d. Glow in the engine so you can see in the engine.
3. The maximum time for glow plug operation is:
   - a. One minute
   - b. Two minutes
   - c. Five minutes
   - d. Thirty seconds.

Answers:

1. d
2. c
3. b

Practical Application:

Students will remove and install a glow plug in accordance with manufacturer's specifications and procedures.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 73 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 73 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING GLOW PLUGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	**Unsatisfactory**
1. Made sure glow plug switch was off.		
2. Located glow plug.		
3. Removed dirt and debris from glow plug mounting area with compressed air.		
4. Disconnected electrical wire from glow plug.		
5. Used appropriate size socket or special tool to loosen and withdraw glow plug.		
6. Installed replacement glow plug and torqued or secured to manufacturer's specifications.		
7. Reattached electrical wire.		
8. Tested for operation.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 74

TASK: R & R ignition system primary resistor.

STANDARD OF PERFORMANCE OF TASK:

Resistor must be securely installed and connected according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement resistor
List of manufacturer's specifications
Test light or volt-ohmmeter
Volt-ohmmeter.

ENABLING OBJECTIVES:

1. Locate replacement resistor.
2. Read and interpret manufacturer's specifications.
3. Use volt-ohmmeter.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp. 352-357

TEACHING ACTIVITIES:

1. Read and discuss **Auto Mechanics Theory and Service,** pp. 352-357.
2. Lecture on the need for the ballast resistor in the primary ignition system.
3. Demonstrate how to test the resistor for serviceability.
4. Demonstrate how to properly remove and replace a ballast resistor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 74

CRITERION-REFERENCED MEASURE:

Questions:

1. A Ballast Resistor:
    a. Cuts twelve volts down to six
    b. Steps six volts up to twelve
    c. Cuts the voltage down to a predetermined amount
    d. Has nothing to do with the ignition system.
2. When replacing a ballast resistor you should always:
    a. Replace the resistor with the car running
    b. Make sure the ignition is off
    c. Remove the battery first
    d. Remove the distributor first.
3. When connecting a Ballast Resistor:
    a. It goes between the coil and the distributor
    b. It goes between the distributor and the spark plugs
    c. It goes on the negative side of the coil
    d. It goes between the ignition switch and the coil.

Answers:

1. c
2. b
3 d

Practical Application:

Remove and replace a Ballast Resistor in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 74 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 74 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING IGNITION SYSTEM PRIMARY RESISTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Checked the ignition switch was off.		
2. Located resistor.		
3. Disconnected electrical lines.		
4. Removed mounting hardware.		
5. Removed resistor.		
6. Checked resistance of replacement hardware as necessary.		
7. Installed replacement resistor, reusing hardware as necessary.		
8. Secured resistor.		
9. Reattached electrical connections.		
10. Checked resistance values with manufacturer's specifications.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE IGNITION

PERFORMANCE OBJECTIVE 75

TASK: R & R magnetic pick-up.

STANDARD OF PERFORMANCE OF TASK:

Pick-up must be installed and secured according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement pick-up
Brass feeler gauges or special tools as needed
Volt-ohmmeter.

ENABLING OBJECTIVES:

1. Locate a replacement pick-up.
2. Use set of brass feeler gauges.
3. Use volt-ohmmeter.

RESOURCES:

Webster, **Auto Mechanics,** pp. 324-332.

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics,** pp. 324-332.
2. List the problems that may occur to a magnetic pick-up.
3. In a guided learning activity, have the students remove the distributor.
4. Demonstrate how to test a pick-up coil for serviceability.
5. Demonstrate how to properly remove and replace the magnetic pick-up coil.
6. Have the students replace the distributor.
7. Students complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 75

CRITERION-REFERENCED MEASURE:

Questions:

1. When replacing a magnetic pick-up:
   a. The engine must be running,
   b. The engine must be off and ignition switch off,
   c. The engine must be off and ignition switch on,
   d. The engine must be running and ignition switch off.
2. The magnetic coil is located:
   a. On the firewall
   b. On the fender well
   c. In the distributor
   d. In the glove box.
3. When testing the coil you are testing:
   a. The amount of voltage coming out
   b. The amount of magnetism inside
   c. The voltage going into the coil
   d. The amount of resistance in the coil.

Answers:

1. b
2. c
3. d

Practical Application:

The student will remove and replace a magnetic pick-up coil in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 75 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 75 EVALUATION:

PERFORMANCE TEST FOR R & R A MAGNETIC PICK-UP

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Checked that ignition switch was off.		
2. Removed components as necessary for access to the distributor.		
3. Removed distributor cap.		
4. Removed distributor components as necessary for access to pick-up.		
5. Disconnected pick-up wire connectors.		
6. Loosened or removed pick-up mounting hardware as necessary.		
7. Removed pick-up from distributor.		
8. Tested replacement pick-up to manufacturer's specifications.		
9. Installed replacement pick-up in distributor.		
10. Adjusted pick-up air gap as necessary to manufacturer's specifications.		
11. Reattached pick-up electrical connections.		
12. Replaced components removed for access to pick-up.		
13. Started engine: verified operation of pick-up.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

MAINTAINING THE FUEL SYSTEM

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 76

TASK: Adjust carburetor anti-stall dash-pot.

STANDARD OF PERFORMANCE OF TASK:

Dash-pot adjustment must be adjusted to prevent stalling as specified by manufacturer.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tachometer or tune-up analyzer
List of manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Use a tachometer.
3. Read and interpret manufacturer's specifications.

RESOURCES:

Automotive Mechanics, p. 155

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** p. 155.
2. Lecture on the importance of keeping the dash-pot working properly.
3. Demonstrate how to determine whether or not the dash-pot is working properly.
4. Demonstrate how to properly adjust the dash-pot.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCED OBJECTIVE 76

CRITERION-REFERENCED MEASURE:

Questions:

1. The dash-pot is located:
   a. On the distributor
   b. On the carburetor
   c. In the carburetor
   d. On the fuel pump.
2. The purpose of the dash-pot is:
   a. Cut fuel off from the carburetor
   b. Advance the ignition system to give more spark
   c. Slow the retarding of the throttle down during deceleration
   d. To cook in.
3. You adjust the dash-pot by:
   a. Turning a screw
   b. Adjusting a bolt
   c. Bending a tab
   d. Depends on how the manufacturer has it mounted.

Answers:

1. b
2. c
3 d

Practical Application:

The student will adjust a carburetor dash-pot with 100 percent accuracy.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 76 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 76 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING A CARBURETOR ANTI-STALL DASH-POT

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located anti-stall dash-pot.		
2. Verified method of adjustment using service manual.		
3. Warmed engine to normal operating temperature		
4. Adjusted dash-pot to manufacturer's specifications using adjustment screw, bolt, movable bracket or by bending linkage as required.		
5. Verified that dash-pot-to-linkage clearances are as specified.		
6. Disconnected any test equipment used.		
7. Road tested vehicle to check that device prevents engine stall as intended by manufacturer.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

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DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 77

TASK: Adjust curb idle mixture.

STANDARD OF PERFORMANCE OF TASK:

Carburetor idle mixture, speed, and emissions level must be within manufacturer's specified range.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tune-up analyzer or tachometer
Propane assist idle mixture special tool if required
Infra-red tester if required
EPA emission label or manufacturer's specifications
Special mixture screw adjusting tools if required
Manufacturer's service manual.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Use tune-up analyzer.
3. Read and interpret manufacturer's service manual.

RESOURCES:

Crouse. **Automotive Mechanics,** pp. 173-174

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 173-174.
2. Lecture on the need for adjusting curb idle speed properly.
3. Demonstrate how to test for proper curb idle speed.
4. Demonstrate how to properly adjust curb idle speed.
5. In a guided learning activity, have students practice adjusting a carburetor.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 77

CRITERION-REFERENCED MEASURE:

Questions:

1. When adjusting the curb idle speed:
   a. The engine must be off.
   b. The engine must be warm and running.
   c. The carburetor must be off the engine.
   d. The engine must be removed.
2. When adjusting the idle mixture, you are adjusting:
   a. The fuel to the carburetor
   b. The air into the engine from the carburetor
   c. How much fuel will enter the engine from the carburetor
   d. The air to fuel ratio of the fuel pump.
3. The adjustment for curb idle speed is a:
   a. Needle and seat valve
   b. Ball valve
   c. Sliding gate valve
   d. Check valve.

Answers:

1. b
2. c
3. a

Practical Application:

The student will adjust a carburetor curb idle mixture with 100 percent accuracy.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 77 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 77 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING CURB IDLE MIXTURE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Determined correct procedure according to manufacturer's specifications		
2. Attached tachometer, tune-up analyzer, infra-red tester or propane idle adjustment equipment as required.		
3. Warmed engine to normal operation temperature.		
4. Turned on, off or disconnected accessories per manufacturer's instructions.		
5. Checked that choke valve and thermostatic air cleaner valve were open.		
6. Gained access to idle mixture screws or used special tools.		
7. Turned idle mixture screws to achieve correct HC/CO or lean idle speed RPM drop as required.		
8. Checked that idle rpm is at specification.		
9. Reset idle to specification and recheck for correct idle mixture adjustment.		
10. Reattached any components as required.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 78

TASK: R & R carburetor air cleaner assembly.

STANDARD OF PERFORMANCE OF TASK:

Carburetor air cleaner assembly must be removed and reinstalled with all vacuum lines and/or electrical connections correctly located, installed and secure.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Identify a replacement air cleaner assembly.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 132-135

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 132-135.
2. Lecture on the need for an air filter in the cleaner assembly.
3. Give some problems that occur because of filters being dirty.
4. Demonstrate how to properly remove and replace an air filter assembly.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 78

CRITERION-REFERENCED MEASURE:

Questions:

1. The purpose of the air filter assembly is to:
   a. Filter air going to the engine
   b. Filter air going to the exhaust
   c. Filter fuel going to the carburetor
   d. Filter air leaving the engine.
2. Filtering of the air is accomplished by:
   a. A removable paper element
   b. An oil bath
   c. A reusable air filter element
   d. All of the above.
3. Which system listed below does not require an air filter?
   a. Fuel injection
   b. Carburetion
   c. Turbo charged
   d. None of the above.

Answers:

1. a
2. d
3 d

Practical Application:

The student will remove and replace a carburetor air cleaner assembly with 100 percent accuracy.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 78 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 78 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING A CARBURETOR AIR CLEANER ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Disconnected any component as necessary to gain access to air cleaner assembly.		
2. Removed air cleaner cover.		
3. Disconnected vacuum hoses and/or electrical connections.		
4. Unfastened air cleaner main housing from carburetor or engine area.		
5. Lifted air cleaner assembly from carburetor or engine area.		
6. Made sure air cleaner to carburetor gasket was in place.		
7. Reinstalled air cleaner assembly to carburetor or engine.		
8. Reconnected vacuum hoses and/or electrical connections.		
9. Reinstalled and secured air cleaner cover.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 79

TASK: Clean carburetor air cleaner element.

STANDARD OF PERFORMANCE OF TASK:

Air cleaning unit must be cleaned according to manufacturer's specifications; unit cannot be damaged; air flow must not be restricted beyond manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania .

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Parts washing equipment as required
Source of compressed air
Blow gun
Shoplight
Cleaning cloths
Replacement oil if required.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Locate a source of compressed air.
3. Use blowgun.

RESOURCES:

Webster, **Auto Mechanics**, pp. 227-228

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics,** pp. 227-228
2. Discuss the reasons you would want to clean instead of replacing a filter.
3. In a guided learning activity, have the students remove the air cleaner.
4. Demonstrate the proper procedure for cleaning a filter element.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 79

CRITERION-REFERENCED MEASURE:

Questions:

1. When cleaning an air filter with a sponge wrapper you should:
    a. Take it off and throw it away
    b. Leave it on while cleaning
    c. Clean it separately
    d. Take it off while cleaning but don't mess with it.
2. Air filters should:
    a. Never be cleaned only thrown away and replaced,
    b. Be cleaned only when they can be cleared of all obstructions,
    c. Taken out and thrown away since you don't need them,
    d. None of the above.
3. When cleaning air filters:
    a. Always blow dirt from inside out,
    b. Wash sponge and metal filters only -- not paper filters.
    c. Hit the filter on a solid object with the top up to loosen dirt.
    d. All of the above.

Answers:

1. c
2. b
3. d

Practical Application:

The student will clean a carburetor air cleaner element according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 79 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 79 EVALUATION:

PERFORMANCE TEST FOR CLEANING CARBURETOR AIR CLEANER ELEMENT

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner element.		
2. Removed sponge wrapper from dry-type element if used.		
3. Washed sponge wrapper in solvent or mineral spirits.		
4. Added oil to sponge wrapper as specified by manufacturer and squeezed into sponge thoroughly.		
5. Struck dry element bottom side down on floor or hard surface several times.		
6. Blew out dirt with approved blowgun, blowing from inside out only.		
7. Looked through paper from outside at a shoplight inside and made sure shoplight was visible to verify filter was not clogged.		
8. Reinstalled sponge wrapper if required.		
9. Reinstalled air cleaner element into carburetor air cleaner assembly.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 80

TASK: Clean automatic choke components.

STANDARD OF PERFORMANCE OF TASK:

Choke components must be clean of dirt, varnish and residue, and move freely with no binding and must update according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Carburetor cleaning solvent
Carburetor with automatic choke.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Describe carburetor cleaning solvent.
3. Identify a carburetor with an automatic choke.

RESOURCES:

Webster, **Auto Mechanics**, pp. 228-229

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics**, pp. 228-229.
2. Lecture on the problems that would cause you to have to clean a choke.
3. In a guided learning activity, have the students remove the air cleaner.
4. Demonstrate how to properly remove a choke assembly.
5. Demonstrate how to properly disassemble and clean the choke assembly.
6. In a guided learning activity, have the students replace the choke assembly.
7. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 80

CRITERION-REFERENCED MEASURE:

Questions:

1. To properly clean a choke assembly:
   a. The carburetor should be removed,
   b. The choke assembly should be removed from the carburetor,
   c. You can leave it on the carburetor,
   d. You can't clean one, it must be replaced.
2. The automatic choke should be cleaned in:
   a. An approved cleaner
   b. Gasoline
   c. Kerosene
   d. Soap and water.
3. The purpose of the automatic choke is to:
   a. Choke the engine down in case of an emergency,
   b. Cut off the fuel supply until the engine warms up,
   c. Cut off the air supply causing a richer fuel mixture,
   d. None of the above.

Answers:

1. b
2. a
3. c

Practical Application:

The student will clean carburetor automatic choke components according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 80 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 80 EVALUATION:

PERFORMANCE TEST FOR CLEANING AUTOMATIC CHOKE COMPONENTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Gained access to choke components.		
2. Sprayed choke components with cleaning solvent.		
3. Operated choke components manually to work cleaner into bearing areas.		
4. Replaced any parts which were removed to gain access.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 81

TASK: R & R anti-dieseling device.

STANDARD OF PERFORMANCE OF TASK:

Anti-dieseling device functions to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
List of manufacturer's specifications
Replacement anti-dieseling device.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Read and interpret manufacturer's specifications.
3. Identify an anti-dieseling device.

RESOURCES:

deKryger et al., **Auto Mechanics Theory and Service,** p. 208

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics Theory and Practice,** p. 208.
2. Lecture on the reasons that would cause an engine to diesel.
3. Demonstrate how to properly adjust the anti-dieseling device.
4. Demonstrate how other systems would cause an engine to diesel.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 81

CRITERION-REFERENCED MEASURE:

Questions:

1. The anti-dieseling device controls:
   a. Fuel and air going into the engine on shut down,
   b. The ignition going to the engine on shut down,
   c. Both a and b
   d. None of the above.
2. Dieseling can be caused by:
   a. Gas continuing to enter the engine on shut down,
   b. Hot spots inside the cylinders,
   c. Incorrect timing
   d. All of the above.
3. Dieseling can be corrected by:
   a. Adjusting the anti-dieseling device,
   b. Adjusting the timing,
   c. Eliminating hot spots (carbon deposits) in the engine,
   d. All of the above.

Answers:

1. a
2. d
3. d

Practical Application:

The student will remove and replace an anti-dieseling device according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 81 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 81 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING ANTI-DIESELING DEVICE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Disconnected battery where applicable.		
2. Located anti-dieseling device.		
3. Removed components as necessary to gain access.		
4. Disconnected electrical connections and/or vacuum lines.		
5. Removed anti-dieseling device fastening hardware.		
6. Removed anti-dieseling device.		
7. Reinstalled replacement anti-dieseling device.		
8. Reattached anti-dieseling device fastening hardware hand-tight.		
9. Adjusted anti-dieseling device per manufacturer's specifications.		
10. Secured fastening hardware.		
11. Verified function of anti-dieseling device.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 82

TASK: Adjust automatic choke.

STANDARD OF PERFORMANCE OF TASK:

Choke moves freely and closes when cold. Choke begins opening and opens at described rate.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Describe a tachometer
3. Use temperature probe.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 148-151.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 148-151.
2. Lecture on the problems that are encountered in trying to adjust an automatic choke.
3. In a guided learning activity, have the students prepare the car to be adjusted.
4. Demonstrate how to properly adjust an automatic choke.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 82

CRITERION-REFERENCED MEASURE:

Questions:

1. The automatic choke can only be set:
   - a. When the engine is hot
   - b. When the engine is cold
   - c. When the engine is off
   - d. None of the above.
2. The automatic choke is operated by:
   - a. A spring
   - b. Exhaust Pressure
   - c. An electric solenoid
   - d. None of the above.
3. The automatic choke works by:
   - a. Drawing more air in while the engine is cold
   - b. Drawing more air in while the engine is hot
   - c. Drawing more fuel in while the engine is cold
   - d. Drawing more fuel in while the engine is hot.

Answers:

1 b
2. a
3. c

Practical Application:

The student will adjust an automatic choke according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 82 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 82 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING AUTOMATIC CHOKE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Connected tachometer.		
2. Removed components as necessary to gain access to automatic choke.		
3. Started engine.		
4. Set fast idle screw on fast idle cam.		
5. Adjusted fast idle speed to manufacturer's specifications.		
6. Loosened choke cap or other adjustment mechanism.		
7. Adjusted choke cap to proper index setting.		
8. Tightened choke cap adjustment locking hardware.		
9. Checked that choke works freely and closes when cold and set.		
10. Reinstalled any components removed for access.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 83

TASK: R & R automatic choke components.

STANDARD OF PERFORMANCE OF TASK:

Replaced automatic choke component and installed properly. Replaced automatic choke component functions as per manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement automatic choke components.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Identify automatic choke components.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 148-151.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 148-151.
2. Lecture on the different types of automatic chokes available.
3. Demonstrate how to properly remove an automatic choke.
4. Demonstrate how to determine the serviceability of the choke components.
5. Demonstrate how to properly replace an automatic choke.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 83

CRITERION-REFERENCED MEASURE:

Questions:

1. To remove automatic choke components the engine should be:
   a. Hot
   b. Cold
   c. Running
   d. None of the above.
2. Which of the following would be an indication that the automatic choke is not working?
   a. The car is hard to start
   b. The car will not stay running on cold mornings
   c. Neither a or b
   d. Both a and b.
3. The most common problem to automatic chokes is:
   a. Components sizing up due to lack of maintenance
   b. Parts wearing out
   c. Parts falling off
   d. Parts failing to get enough fuel.

Answers:

1. b
2. d
3. a

Practical Application:

The student will remove and replace choke assembly components according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 83 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 83 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING AUTOMATIC CHOKE COMPONENTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located components to be R & R .		
2. Removed components as necessary to gain access to automatic choke component to be R & R.		
3. Unfastened automatic choke component as necessary.		
4. Removed component.		
5. Reinstalled replacement component.		
6. Refastened replacement component.		
7. Checked that component functions as per manufacturer's specifications.		
8. Reinstalled any components removed to gain access.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 84

TASK: Free up manifold heat control valve.

STANDARD OF PERFORMANCE OF TASK:

Manifold heat control valve must move through full range of movement as engine warms up.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Exhaust manifold heat control solvent.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Identify an exhaust manifold heat control.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 151-152.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, pp. 151-152.
2. Lecture on the problems that plague manifold heat control valves.
3. In a guided learning activity, have the students prepare the engine for access.
4. Demonstrate how to properly free up a manifold heat control valve.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 84

CRITERION-REFERENCED MEASURE:

Questions:

1. The purpose of the heat riser valve is to:
   a. Use exhaust to cool the engine down,
   b. Divert exhaust into the intake to help give the engine more power,
   c. Divert exhaust into the intake to heat up fuel going to the cylinders,
   d. Divert exhaust to the outside to boost power.
2. The primary cause of heat riser failure is:
   a. Rust
   b. Metal fatigue
   c. Too much heat
   d. Too much cold.
3. The only engine to use a heat riser control is:
   a. A four cylinder
   b. A six cylinder
   c. A eight cylinder
   d. All of the above.

Answers:

1. c
2. a
3. d

Practical Application:

The student will free up a manifold heat control valve so that the valve moves through its full range of movement as the engine warms up.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 84 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 84 EVALUATION:

PERFORMANCE TEST FOR FREEING UP MANIFOLD HEAT CONTROL VALVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Checked to assure that engine is cold.		
2. Removed components as necessary to gain access to heat control valve.		
3. Tapped valve shaft lightly with hammer, side to side if it was immovable.		
4. Sprayed heat control valve solvent onto shaft on both sides where possible. (Did not use engine oil)		
5. Worked valve by hand through range of movement to loosen it to operate without binding or sticking.		
6. Resprayed heat control valve shaft with solvent to flush out grit or carbon or rust particles.		
7. Checked free movement of heat control valve.		
8. Reinstalled any components removed to gain access.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 85

TASK: R & R manifold heat control valve.

STANDARD OF PERFORMANCE OF TASK:

Valve must be installed in position specified by manufacturer, and not bind or leak exhaust gases.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement manifold heat control valve
Replacement gaskets
Penetrating oil.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Describe the operation of a exhaust manifold heat control valve
3. Locate replacement gaskets
4. Identify penetrating oil.

RESOURCES:

Crouse, **Automotive Mechanics**, pp: 151-152.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, pp. 151-152.
2. Discuss the reasons for maintaining the manifold heat control valve in good working order.
3. Demonstrate how to properly remove a manifold heat control valve.
4. Demonstrate how to evaluate the removed part and determine its serviceability.
5. Demonstrate how to replace the valve properly.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 85

CRITERION-REFERENCED MEASURE:

Questions:

1. When removing and replacing the manifold heat control valve the engine should be:
   a. Off and cooled down
   b. Running but cool
   c. Running and hot
   d. Off but hot.
2. Which of the following statements is true?
   a. All heat riser valves are the same,
   b. Heat riser valves only come on V-8 engines,
   c. Heat riser valves help the efficiency of the engine,
   d. Heat riser valves do nothing for the performance of the engine.
3. Manifold heat control valves are used primarily on:
   a. Early model engines
   b. Late model engines
   c. All engines
   d. None of the above.

Answers:

1. a
2. c
3. a

Practical Application:

The student will remove and replace a manifold heat control valve so not to bind or leak exhaust gases.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 85 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 85 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING MANIFOLD HEAT CONTROL VALVE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
(V-Type engine with separate valve assembly)		
1. Applied penetrating oil on nuts and bolts that secured valve.		
2. Removed nuts and bolts and pulled down exhaust pipe to gain access to valve.		
3. Removed the valve assembly.		
4. Scraped off all old gasket material from manifold and exhaust pipe flange.		
5. Installed the replacement valve between exhaust manifold and exhaust pipe using new gaskets.		
6. Replaced, tightened and torqued the nuts and bolts.		
7. Started engine and checked operation of heat control valve.		
(Straight-Type engine with valve in manifold)		
1. Removed the manifold which contains the valve.		
2. Disassembled the heat control valve according to manufacturer's procedures.		
3. Removed the valve plate from the manifold.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 85 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
4. Installed the new heat control valve parts in the manifold.		
5. Mounted the counterweight and thermostatic coil spring, applying tension to spring according to manufacturer's procedures.		
6. Checked the valve for free operation.		
7. Cleaned the manifold mounting surfaces and reinstalled the manifold and exhaust pipe.		
8. Started engine and checked for proper valve operation.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 86

TASK: Adjust carburetor float.

STANDARD OF PERFORMANCE OF TASK:

Carburetor float level and float drop must be adjusted to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Float setting gauge or special tool as required by manufacturer
Flare nut line wrench assortment
List of manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Locate a float setting gauge
3. Describe a flare nut wrench
4. Locate the manufacturer's specifications.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 142-143.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 142-143.
2. Lecture on the problems caused by improper float settings.
3. Lecture on the causes of improper float level.
4. In a guided learning activity have the students gain access to the carburetor.
5. Demonstrate how to properly gain access to the float level adjustment.
6. Demonstrate how to properly adjust the float level.
7. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 86

CRITERION-REFERENCED MEASURE:

Questions:

1. Why is it necessary to maintain a certain amount of fuel within the carburetor?
    a. It is not necessary
    b. In order to supply fuel at needed times
    c. To prevent flooding
    d. Both b and c.
2. Which of the following could be an indication that the float is not adjusted properly?
    a. The car is hard to start
    b. The car will not stay running
    c. The car will run only at high speeds
    d. All of the above.
3. The carburetor floats control the fuel going into the carburetor:
    a. By a needle and seat valve
    b. By a check valve
    c. By shutting off the fuel pump
    d. None of the above.

Answers:

1. d
2. d
3. a

Practical Application:

The student will adjust the float level in a carburetor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 86 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 86 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING THE CARBURETOR FLOAT

Student's Name Date

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100% is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air horn from carburetor to gain access to float.		
2. Measured gap between float and air horn body when air horn was turned over.		
3. Adjusted float level by bending adjustment tang where applicable, or by adjusting needle valve seat according to manufacturer.		
4. Turned air horn over so float drops to lowest level.		
5. Measured float drop and compared with specifications.		
6. Adjusted float drop if necessary.		
7. Repeated steps 2,3,4 and 5 as necessary until both measurements were as specified.		
8. Added clean fuel to fuel bowl to raise float and rechecked that adjustment is correct.		
9. Reinstalled components removed to gain access. (Caution--do not touch plastic floats with fingers or allow contamination by oil. Do not compress virton needle valve tip during float adjustment on models so equipped).		
10. Replaced air horn.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 87

TASK: Adjust anti-dieseling device.

STANDARD OF PERFORMANCE OF TASK:

Anti-dieseling device is secured and adjusted to manufacturer's specifications, and functions to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
List of manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Read manufacturer's specifications.

RESOURCES:

Crouse, **Automotive Mechanics**, pp.153-155.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, pp.153-155.
2. Lecture on the reasons why an engine would need an anti-dieseling device.
3. Demonstrate how to properly determine whether the anti-dieseling device needs to be adjusted.
4. In a guided learning activity have the students gain access to the anti-dieseling device.
5. Demonstrate how to properly adjust the anti-dieseling device.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 87

CRiTERION-REFERENCED MEASURE:

Questions:

1. What is another name for the anti-dieseling device?
   a. Throttle positioner
   b. Cold stop solenoid
   c. Hot stop solenoid
   d. Idle stop solenoid.
2. Which of the following could be an indication that the anti-dieseling device is not working?
   a. The car is hard to start.
   b. The car will not stay running on cold mornings.
   c. The car continues to run when it is turned off.
   d. Both a and b.
3. The anti-dieseling device shuts off:
   a. Fuel to the carburetor
   b. Air to the carburetor
   c. Electricity going to the distributor.
   d. Oil to the oil pump.

Answers:

1. d
2. c
3. b

Practical Application:

The student will adjust the anti-dieseling device according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 87 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 87 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING ANTI-DIESELING DEVICES.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completed the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located anti-dieseling device.		
2. Determined method of adjustment using manufacturer's specifications.		
3. Checked adjustment of anti-dieseling device using appropriate measurement device.		
4. Loosened anti-dieseling adjusting hardware where necessary.		
5. Moved adjustment to manufacturer's specifications.		
6. Secured adjustment where necessary.		
7. Tested function of anti-dieseling device.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 88

TASK: Adjust carburetor metering rods.

STANDARD OF PERFORMANCE OF TASK:

Metering rods must be adjusted to manufacturer's specifications with no fuel leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special measuring tools as necessary per manufacturer's specifications
List of manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Read manufacturer's specifications.

RESOURCES:

Crouse, William H., **Automotive Mechanics**, pp. 146-147

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, pp. 146-147.
2. Lecture on the function of the metering rods.
3. In a guided learning activity have the students gain access to the carburetor.
4. Demonstrate how to properly adjust a set of metering rods.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 88

CRITERION-REFERENCED MEASURE:

Questions:

1. What is the purpose of the metering rods?
    a. They add more fuel to the carburetor at high speeds.
    b. They open up and allow the carburetor to draw more fuel in as needed at high speeds.
    c. They meter fuel at any throttle setting.
    d. None of the above.
2. When adjusting the metering rods it is important not to:
    a. Tear the gaskets
    b. Bend the metering rods
    c. Allow contaminants into the carburetor
    d. All of the above.
3. Metering rods for the carburetor are always located:
    a. Inside the carburetor
    b. Outside the carburetor
    c. On the fuel line
    d In the gas tank.

Answers:

1. b
2. d
3. a

Practical Application:

The student will adjust the metering rods according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 88 to determine if the assignment was completed with 100 percent accuracy and no fuel leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 88 EVALUATION:

PERFORMANCE TEST FOR ADJUSTING METERING RODS IN A CARBURETOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner assembly.		
2. Gained access to metering rods as required.		
3. Used proper procedure per manufacturer and used correct measuring, in measuring metering rod adjustment.		
4. Loosened metering rod adjustment.		
5. Adjusted metering rods to manufacturer's specifications.		
6. Reinstalled components removed to gain access.		
7. Tightened metering rod adjustment and secured.		
8. Reinstalled air cleaner.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 89

TASK: R & R accelerator pump.

STANDARD OF PERFORMANCE OF TASK:

Accelerator pump must be installed, adjusted and secured as per manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special measuring tools as per manufacturer's specifications
List of manufacturer's specifications
Replacement accelerator pump.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Read manufacturer's specifications
3. Identify an accelerator pump.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 147-149.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** p. 147-149.
2. Lecture on the need for an accelerator pump.
3. Discuss with the students the problems encountered when the accelerator pump fails.
4. Demonstrate how to properly remove and replace an accelerator pump according to manufacturer's specifications.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 89

CRITERION-REFERENCED MEASURE:

Questions:

1. The accelerator pump adds fuel:
    a. Only on cold starts in the morning
    b. At any time when the throttle is accelerated quickly
    c. Only at high speeds when more gas is needed
    d. Only at low speeds below idle.
2. The accelerator pump is mounted:
    a. On the top of the carburetor
    b. On the bottom of the carburetor
    c. On the side the carburetor.
    d. In any one of the places above.
3. The most likely cause of accelerator pump failure is:
    a. Linkage wearing out
    b. Holes/cracks in the diaphragm
    c. Electrical
    d. Gas clogging it up.

Answers:

1. b
2. d
3. b

Practical Application:

The student will remove and replace the accelerator pump in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 89 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 89 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING ACCELERATOR PUMPS.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Gained access to carburetor.		
2. Removed air cleaner assembly.		
3. Removed carburetor if required.		
4. Disassembled carburetor for access to accelerator pump as required.		
5. Removed accelerator pump fastening hardware as required.		
6. Removed accelerator pump.		
7. Installed replacement accelerator pump.		
8. Adjusted accelerator pump to manufacturer's specifications as required and secured.		
9. Reassembled carburetor as required.		
10. Reinstalled carburetor as required.		
11. Reinstalled air cleaner assembly.		
12. Reinstalled any components removed to gain access.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 90

TASK: R & R carburetor.

STANDARD OF PERFORMANCE OF TASK:

Carburetor must be installed, secured and adjusted to manufacturer's specifications, according to manufacturer's procedure with no fuel or vacuum leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Carburetor base gasket
List of manufacturer's specifications.

ENABLING OBJECTIVE:

1. Use standard tool kit.
2. Identify a carburetor base gasket.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 165-175

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 165-175.
2. Lecture on the different types of carburetors.
3. Explain to students what precautions they should take when removing and replacing a carburetor on an engine.
4. Demonstrate how to properly remove and replace a carburetor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 90

CRITERION-REFERENCED MEASURE:

Questions:

1. When removing a carburetor you must remove:
    a. Fuel lines
    b. Vacuum lines
    c. Electrical connections
    d. All of the above.
2. When adjusting a carburetor (not initial adjustment):
    a. The carburetor must be off the engine
    b. The carburetor must be on the engine and the engine off
    c. The engine must be removed from the car
    d. The engine must be running.
3. When replacing a carburetor, the base gasket:
    a. Should be replaced
    b. Should be sealed and reused
    c. Should be thrown away, you don't need it
    d. Should be soaked in gasoline for 10-15 minutes.

Answers:

1. d
2. d
3. a

Practical Application:

The student will remove and replace a carburetor according to manufacturer's specifications and with no fuel or vacuum leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 90 to determine if the assignment was completed with 100 percent accuracy and no fuel or vacuum leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 90 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A CARBURETOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner assembly.		
2. Disconnected throttle linkage.		
3. Disconnected transmission kickdown linkage as required.		
4. Disconnected fuel and vacuum lines and electrical connections as required.		
5. Removed carburetor mounting hardware as required.		
6. Lifted carburetor from manifold.		
7. Rebuilt or obtained replacement carburetor.		
8. Removed carburetor base gasket.		
9. Cleaned manifold carburetor mounting area.		
10. Installed new carburetor base-to-manifold gasket.		
11. Installed carburetor.		
12. Installed and secured carburetor mounting hardware.		
13. Reconnected fuel, vacuum and electrical connections as required.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 90 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
14. Reconnected throttle and transmission linkage as required.		
15. Started engine, warmed up to normal operating temperature.		
16. Adjusted carburetor to manufacturer's specifications.		
17. Reinstalled air cleaner assembly.		

APPROVED: YES _____ NO ____

Evaluator's Signature   Date

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 91

TASK: Rebuild carburetor.

STANDARD OF PERFORMANCE OF TASK:

Carburetor must be cleaned and components replaced as required, and must be adjusted to manufacturer's specifications for flow and mixture with no fuel or air leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special measuring tools as required
List of manufacturer's specifications
Replacement carburetor overhaul kit or components as required
Source of compressed air
Blow gun.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Locate a replacement carburetor overhaul kit
3. Identify a source of compressed air
4. Use blow gun.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service**, pp. 222-228

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics Theory and Service,** pp. 222-228.
2. Lecture on the reasons why you would want to rebuild a carburetor.
3. In a guided learning activity have the students gain access to and remove a carburetor from an engine.
4. Demonstrate how to properly overhaul a carburetor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 91

CRITERION-REFERENCED MEASURE:

Questions:

1. It is a sign of a bad mechanic if he/she must:
   a. Tag all lines
   b. Draw diagrams to help him/her remember where the connections go
   c. Place things in order to help him/her remember where they go
   d. None of the above.
2. When making initial adjustments on a carburetor:
   a. The carburetor should be off the engine
   b. The carburetor must be on the engine and the engine off
   c. The engine must be removed from the car
   d. The engine must be running.
3. When washing a carburetor, it is best to use:
   a. Soap and water
   b. Gasoline
   c. Kerosene
   d. Carburetor cleaning solvent.

Answers:

1. d
2. a
3. d

Practical Application:

The student will rebuild a carburetor according to manufacturer's specifications and with no fuel or air leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 91 to determine if the assignment was completed with 100 percent accuracy and no fuel or air leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 91 EVALUATION:

PERFORMANCE TEST FOR REBUILDING A CARBURETOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner assembly.		
2. Disconnected throttle linkage and transmission linkage as required.		
3. Disconnected fuel, vacuum and electrical connections as required.		
4. Removed carburetor fastening hardware.		
5. Lifted carburetor from manifold.		
6. Disassembled carburetor per manufacturer's specifications.		
7. Soaked carburetor in clean solvent to remove foreign materials.		
8. Rinsed carburetor in hot water and blew dry with shop air--including all passages.		
9. Reassembled carburetor using new components from overhaul kit as required.		
10. Made all adjustments during reassembly as per manufacturer's specifications.		
11. Reinstalled carburetor on manifold.		
12. Reinstalled and secured mounting hardware.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 91 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
13. Reconnected fuel, vacuum and electrical connections and all linkage as required.		
14. Ran engine to normal operating temperature.		
15. Adjusted carburetor to manufacturer's specifications.		
16. Reinstalled air cleaner assembly.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 92

TASK: R & R fuel filter unit.

STANDARD OF PERFORMANCE OF TASK:

Fuel filter must be installed securely with correct direction of flow and no fuel leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement fuel filter unit.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a fuel filter.

RESOURCES:

1. deKryger, et al, **Auto Mechanics Theory and Service,** pp. 190-191

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics Theory and Service**, pp. 190-191.
2. Lecture on the problems that plague fuel filters and what can be done to prevent them.
3. Demonstrate how to properly remove and replace a fuel filter element.
4. Disassemble the filter removed and show the class how well the filter was working.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 92

CRITERION-REFERENCED MEASURE:

Questions:

1. The main problem that occurs to filters is:
   a. Rust particles clogging them up
   b. Water soaking the filter and preventing fuel passage
   c. Dirt coming from tanks
   d. All of the above.
2. When should fuel filters be replaced?
   a. Every month
   b. At 5000 mile intervals
   c. At 10,000 mile intervals
   d. Whenever necessary.
3. When a filter is found to be dirty it is best to:
   a. Clean it and replace it
   b. Leave it, they don't get dirty
   c. Throw it away and replace it
   d. Remove it and leave it out.

Answers:

1. d
2. d
3. c

Practical Application:

The student will remove and replace a fuel filter unit in the correct direction and with no fuel leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 92 to determine if the assignment was completed with 100 percent accuracy and no fuel leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 92 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A FUEL FILTER UNIT.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	**Unsatisfactory**
1. Located fuel filter unit.		
2. Loosened fuel filter attachment hardware as required.		
3. Disconnected fuel lines.		
4. Removed fuel filter unit.		
5. Installed replacement fuel filter unit in proper direction of flow.		
6. Reinstalled and secured fuel lines.		
7. Reinstalled and secured attachment hardware as required.		
8. Ran engine and checked for leaks.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 93

TASK: R & R electric fuel pump.

STANDARD OF PERFORMANCE OF TASK:

There must be no fuel or oil leaks in repair area and all electrical connections must be secured.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement fuel pump and installation kit as necessary
Electrical connector as required
Fuel siphon and fuel container if necessary
Fuel line plugs.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a fuel pump
3. Describe a fuel line plug.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 131-132.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 131-132.
2. Lecture on the different types of fuel pumps.
3. In a guided learning activity have the students gain access to the fuel pump.
4. Demonstrate how to properly remove and replace a fuel pump.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 93

CRITERION-REFERENCED MEASURE:

Questions:

1. Electrical fuel pumps run only when:
    a. The engine is running
    b. When the ignition is on
    c. When the ignition is on and there is a demand
    d. Only on demand.
2. Electrical fuel pumps are mounted:
    a. In the fuel tank
    b. On the firewall.
    c. Under the car
    d. Any of the above.
3. The first indication that the fuel pump has quit working is:
    a. The engine surges
    b. The engine quits working
    c. The gas gage quits working
    d. You get a strong smell of gas in the car.

Answers:

1. c
2. d
3. b

Practical Application:

The student will remove and replace a fuel pump and all electrical connections must be secured with no fuel or oil leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 93 to determine if the assignment was completed with 100 percent accuracy and no fuel or oil leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 93 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING ELECTRIC FUEL PUMP.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Disconnected battery.		
2. Located and gained access to fuel pump.		
3. Disconnected and plugged fuel lines.		
4. Disconnected electrical connections.		
5. R & R fuel pump mounting hardware.		
6. Removed fuel pump mounting hardware.		
7. Removed fuel pump.		
8. Cleaned fuel pump mounting area of corrosion or foreign material.		
9. Installed replacement fuel pump including any necessary installation kit per manufacturer's specifications.		
10. Reconnected fuel lines and secured.		
11. Reattached electrical connections and secured.		
12. Reinstalled fuel tank and/or fuel as necessary.		
13. Reconnected battery.		
14. Reinstalled components as necessary removed to gain access.		
15. Ran pump and checked operation.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 94

TASK: R & R mechanical fuel pump.

STANDARD OF PERFORMANCE OF TASK:

There must be no fuel or oil leaks in repair area.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement fuel pump and mounting gasket
Gasket scraper.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Locate a replacement mechanical fuel pump.
3. Use gasket scraper.

RESOURCES:

Crouse, **Automotive Mechanics**, p. 129

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, p. 129.
2. Lecture on the problems that occur to mechanical fuel pumps.
3. In a guided learning activity have the students gain access to the fuel pump.
4. Demonstrate how to properly remove and replace a fuel pump.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 94

CRITERION-REFERENCED MEASURE:

Questions:

1. The purpose of a fuel pump is:
    a. To supply a positive flow of fuel to the carburetor,
    b. To pump fuel on demand,
    c. To aid the carburetor when it draws the fuel in,
    d. To measure the amount of fuel to the carburetor.
2. Mechanical fuel pumps are mounted?
    a. In the fuel tank
    b. On the firewall
    c. Under the car
    d. On the engine.
3. Most mechanical fuel pumps used on cars today are what type?
    a. Gear
    b. Piston
    c. Diaphragm
    d. Plunger.

Answers:

1. a
2. d
3. c

Practical Application:

The student will remove and replace a fuel pump with no fuel or oil leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 94 to determine if the assignment was completed with 100 percent accuracy and no fuel or oil leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 94 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING MECHANICAL FUEL PUMP.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located and gained access to fuel pump.		
2. Disconnected and plugged fuel lines.		
3. Removed fuel pump fastening hardware and removed pump.		
4. Cleaned fuel pump mounting area of old gasket material and any foreign matter.		
5. Installed replacement fuel pump with new mounting gasket.		
6. Reinstalled and secured fuel pump fastening hardware.		
7. Reattached and secured fuel lines.		
8. Reinstalled any components removed to gain access.		
9. Ran engine and checked for leaks.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 95

TASK: R & R electrical fuel injection components.

STANDARD OF PERFORMANCE OF TASK:

Components(s) must be installed following manufacturer's procedures and with all electrical connections secured.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special tools as required by manufacturer
Replacement electronic fuel injection component.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Use replacement electronic fuel injection component.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 180-188

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 180-188.
2. Lecture on the problems that occur to electronic fuel injection system.
3. In a guided learning activity, have the students gain access to the components to be replaced.
4. Demonstrate how to properly remove and replace the component chosen.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 95

CRITERION-REFERENCED MEASURE:

Questions:

1. The problem that plagues electronic fuel injection systems the most is:
   a. Bad injectors
   b. Fuel pumps going out
   c. Trash in the fuel lines
   d. They don't have problems.
2. Electronic fuel injection systems operate on what kind of fuel pressure?
   a. High
   b. Low
   c. Medium
   d. None of the above.
3. The injectors are usually mounted:
   a. At the base of the throttle
   b. At the base of the manifold
   c. In the head
   d. Depends on the system.

Answers:

1. c
2. a
3. d

Practical Application:

The student will remove and replace an electronic fuel injection component following manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 95 to determine if the assignment was completed with 100 percent accuracy and all electrical connections secured.

CHECKLIST FOR PERFORMANCE OBJECTIVE 95 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING ELECTRONIC FUEL INJECTION COMPONENTS.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located and gained access to component to be replaced.		
2. Disconnected battery.		
3. Disconnected and plugged fuel line as required.		
4. Disconnected electrical connections as required.		
5. Removed fuel injection component attachment hardware.		
6. Removed fuel injection component.		
7. Cleaned fuel injection component mounting area as required.		
8. Installed replacement fuel injection component.		
9. Reinstalled and secured fuel injection component attachment hardware.		
10. Reconnected electrical connections as necessary.		
11. Reconnected fuel lines and secured if necessary.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 95 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
12. Reinstalled components removed to gain access as necessary.		
13. Reconnected battery.		
14. Ran and checked for leaks and proper function of component which was replaced.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 96

TASK: R & R fuel injection nozzle (gasoline).

STANDARD OF PERFORMANCE OF TASK:

Nozzle must be fully seated; securing clamps must be tight and fuel must not leak.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Injection nozzle.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement fuel injection nozzle.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 176-188.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, pp. 176-188.
2. Lecture on the problems that would cause you to replace an injector nozzle.
3. In a guided learning activity have the students gain access to the injection nozzle to be replaced.
4. Demonstrate how to properly remove and replace a fuel injection nozzle.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 96

CRITERION-REFERENCED MEASURE:

Questions:

1. One of the main problems that occurs to a fuel injection nozzle is:
   a. Trash in injectors
   b. Corrosion
   c. Water damaging the injector
   d. All of the above.
2. What has to be done if you run a gasoline engine (with fuel injection) out of fuel?
   a. The system has to be drained and flushed
   b. All the filters have to be replaced before starting
   c. Nothing, just add fuel and restart
   d. Spray with ether and restart.
3. Injectors can be operated how?
   a. Electrically
   b. Mechanically
   c. By fuel pressure
   d. All of the above.

Answers:

1. d
2. c
3. d

Practical Application:

The student will remove and replace a fuel injection nozzle following manufacturer's specifications with no fuel leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 96 to determine if the assignment was completed with 100 percent accuracy and with no fuel leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 96 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING INJECTION NOZZLES (GASOLINE).

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located and gained access to injection nozzle.		
2. Loosened and removed any electrical connections if used.		
3. Loosened and removed fuel lines to nozzle.		
4. Loosened and removed injection nozzle clamp.		
5. Removed injection nozzle according to manufacturer's instructions.		
6. Set replacement nozzle into original's position.		
7. Seated nozzle into position according to manufacturer's instructions.		
8. Installed nozzle clamp and bolt; torqued to manufacturer's specifications.		
9. Reattached injection lines to nozzle.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 96 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
10. Reattached electrical connections.		
11. Reinstalled any parts removed to gain access to nozzle.		
12. Started engine and checked for leaks; corrected as necessary.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 97

TASK: R & R fuel injection pump (gas or diesel).

STANDARD OF PERFORMANCE OF TASK:

Replacement pump must be installed in accordance with manufacturer's specifications for position, fuel delivery and timing.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Injection pump.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement fuel injection pump.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 420-424.

TEACHING ACTIVITIES:

1. Read and discuss text, **Automotive Mechanics,** pp. 420-424.
2. Lecture on the reasons that would cause you to replace an injection pump.
3. In a guided learning activity have the students gain access to the injection pump to be replaced.
4. Demonstrate how to properly remove and replace fuel injection pump.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 97

CRITERION-REFERENCED MEASURE:

Questions:

1. What are the two types of injection pumps?
   a. Rotary distributor and worm gear
   b. Worm gear and cam-operated in-line plunger
   c. Rotary distributor and cam-operated in-line plunger
   d. Worm gear and reverse piston.
2. What has to be done if you run a diesel engine out of fuel?
   a. The system has to be bled and free of air.
   b. All the filters have to be replaced before starting.
   c. Nothing, just add fuel and restart.
   d. Spray with ether and restart.
3. When replacing an injection pump the key thing is to;
   a. Tighten all fittings
   b. Be sure the pump is secure
   c. Time the pump to the engine
   d. Replace all lines.

Answers:

1. c
2. a
3. c

Practical Application:

The student will remove and replace a fuel injection pump following manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 97 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 97 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING INJECTION PUMP (GAS OR DIESEL).

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed engine parts as necessary to gain access to fuel injection pump. A. Disconnected throttle linkage from pump.		
2. Loosened and removed all electrical connections.		
3. Loosened and removed fuel return line.		
4. Loosened and removed pump to nozzle lines.		
5. Loosened and removed fuel inlet line.		
6. Loosened and removed any brackets, braces, etc. supporting pump assembly.		
7. Loosened and removed injection pump to engine attaching bolts.		
8. Removed injection pump.		
9. Installed new injection pump in original's position.		
10. Aligned timing marks if used.		
11. Installed and tightened engine and engine to pump attaching bolts.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 97 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
12. Reinstalled and tightened pump supporting braces, brackets, etc.		
13. Reinstalled fuel inlet line.		
14. Reinstalled pump to nozzle lines.		
15. Reinstalled fuel return line.		
16. Reattached all electrical connections.		
17. Reattached throttle linkage to pump.		
18. Replaced all parts previously removed to gain access to fuel injection pump.		
19. Bled air from injection system according to manufacturer.		
20. Adjusted pump timing idle, and fast idle settings according to manufacturer's specifications.		
21. Operated engine check for leaks and corrected as necessary.		
22. Checked for correct operation of pump controls and acceleration linkage.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 98

TASK: Repair leaks in fuel injection pump.

STANDARD OF PERFORMANCE OF TASK:

All fuel injection system leaks must be eliminated.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Use a line wrench.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 193-198

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 193-198.
2. Lecture on the problems that cause fuel leaks in injection pumps.
3. In a guided learning activity have the students gain access and remove injection pump if necessary.
4. Demonstrate how to properly repair a leak in the fuel injection pump.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 98

CRITERION-REFERENCED MEASURE:

Questions:

1. What could be the cause of a leak in an injection pump?
   a. Hard gaskets
   b. Case cracked
   c. Loose fittings
   d. All of the above.
2. System operating pressure of a diesel injection pump could run as high as:
   a. 10,000 PSI
   b. 5,000 PSI
   c. 50,000 PSI
   d. 500 PSI.
3. When replacing an injection pump the key thing is to:
   a. Tighten all fittings
   b. Be sure the pump is secure
   c. Time the pump to the engine
   d. Replace all lines.

Answers:

1. d
2. a
3. c

Practical Application:

The student will repair a leak in a fuel injection pump.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 98 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 98 EVALUATION:

PERFORMANCE TEST FOR REPAIRING LEAKS IN FUEL INJECTION PUMP.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located and gained access to fuel injection pump.		
2. Located source of leak removing pump if necessary.		
3. Repaired leaks at fuel line connections by tightening or replacing parts as necessary.		
4. Repaired leaks on pump according to manufacturer's service manuals.		
5. Reinstalled pump or lines previously removed.		
6. Reinstalled parts removed to gain access to pump.		
7. Reset pump timing, idle and fast idle if necessary.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM,

PERFORMANCE OBJECTIVE 99

TASK: R & R turbo-charger.

STANDARD OF PERFORMANCE OF TASK:

New turbo-charger must be installed securely; all electrical connections must be clean and tight. All hoses or lines must be tightened to manufacturer's specifications, with no leakage or seepage at connections. All intake and exhaust piping must be securely attached with no leakage. Turbo-charger must operate according to manufacturer's specifications, with no vibrations or noises. Replacement turbo-charger must be secured in original position with all hoses, wiring and/or linkage connected in accordance with manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Turbo-charger
Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit.
2. Identify replacement turbo-charger.

RESOURCES:

deKryger, et al, **Auto Mechanics Theory and Service**, pp. 181-185

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics Theory and Service**, pp. 181-185.
2. Lecture on the problems that plague turbo-chargers.
3. In a guided learning activity have the students gain access to the turbo-charger.
4. Demonstrate how to properly remove and replace a turbo-charger according to manufacturer's specifications.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 99

CRITERION-REFERENCED MEASURE:

Questions:

1. The problems that occur to a turbo-charger include:
   a. Cracked blades
   b. Case cracked
   c. Loose fittings
   d. All of the above.
2. A turbo-charger receives its power to compress from:
   a. An electric motor,
   b. Off of the engine,
   c. The exhaust,
   d. A turbine.
3. Turbo-chargers:
   a. Recycles exhaust air back through the engine,
   b. Pulls in outside air and forces it in the engine,
   c. Do not add very much power back to the engine,
   d. None of the above.

Answers:

1. d
2. c
3. b

Practical Application:

The student will remove and replace a turbo-charger. The replaced turbo-charger must be secured in the original position with all hoses, wiring and/or linkage connected in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist performance objective 99 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 99 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A TURBO-CHARGER.

Student's Name Date

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed engine parts as necessary to gain access to turbo-charger.		
2. Disconnected any operating linkage from turbo-charger.		
3. Loosened and removed all electrical connections.		
4. Loosened and removed hoses and lines.		
5. Loosened and removed exhaust pipe.		
6. Loosened and removed piping from turbo-charger to carburetor and intake manifold.		
7. Loosened and removed any brackets, braces, etc. supporting the turbo-charger assembly.		
8. Loosened and removed turbo-charger mounting bolts.		
9. Removed turbo-charger.		
10. Installed new turbo-charger in original's position.		
11. Reinstalled and retightened mounting bolts.		
12. Installed and tightened supporting braces, brackets, etc.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 99 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
13. Installed piping from turbo-charger to carburetor and intake manifold.		
14. Reinstalled exhaust pipe.		
15. Reinstalled hoses and lines.		
16. Reattached all electrical connections.		
17. Reconnected all operating linkages to turbo-charger.		
18. Replaced parts previously removed to gain access to the turbo-charger.		
19. Operated vehicle to verify performance according to manufacturer's specifications.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 100

TASK: R & R fuel lines.

STANDARD OF PERFORMANCE OF TASK:

Fuel line must be installed securely in original position with no leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement fuel line.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Use a line wrench
3. Identify replacement fuel line.

RESOURCES:

Crouse, **Automotive Mechanics,** p. 171

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** p. 171.
2. Lecture on the different types of fuel lines and where they would be used on automobiles.
3. In guided learning activity have the students gain access to the fuel line to be removed.
4. Demonstrate how to properly remove and replace a fuel line.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 100

CRITERION-REFERENCED MEASURE:

Questions:

1. The most common type of fuel line problem is:
   a. Cracks
   b. Kinks
   c. Loose fittings
   d. All of the above.
2. A fuel line must be complete from one end to the other to prevent:
   a. Fuel from coming out
   b. Air from going in
   c. Both a and b
   d. Neither a nor b.
3. Fuel lines used on gasoline automobiles are:
   a. Low pressure type
   b. High pressure type
   c. Combination low and high
   d. Made of asbestos.

Answers:

1. d
2. c
3. a

Practical Application:

The student will remove and replace a fuel line with no fuel leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 100 to determine if the assignment was completed with 100 percent accuracy and no fuel leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 100 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A FUEL LINE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located fuel line to be replaced.		
2. Disconnected inlet and outlet ends of fuel lines and plugged mating lines.		
3. Removed fuel line guide or shield attachment hardware.		
4. Removed any component as necessary for access.		
5. Removed fuel line.		
6. Contoured replacement fuel line to match original fuel line if necessary.		
7. Installed replacement fuel line and secured connections, and removed line plugs.		
8. Routed replacement fuel line along original path.		
9. Reinstalled and secured fuel line guides or shields.		
10. Operated system and checked for leaks.		
11. Reinstalled any components removed to gain access.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM,

PERFORMANCE OBJECTIVE 101

TASK: R & R fuel tank.

STANDARD OF PERFORMANCE OF TASK:

Fuel line must be installed securely in original position with no leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement tank, gaskets and seals
Syphon equipment
Fuel storage canister.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement tank
3. Describe a fuel storage canister.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 126-127

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 126-127.
2. Lecture on the different types of fuel tanks and why.
3. In a guided learning activity have the students gain access to the fuel tank to be replaced.
4. Demonstrate how to properly remove and replace a fuel tank.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 101

CRITERION-REFERENCED MEASURE:

Questions:

1. Fuel tanks generally:
   a. Last for the life of the car
   b. Last for about five years
   c. Last only long enough for the warranty to run out
   d. None of the above.
2. Fuel tanks are made of:
   a. Plastic
   b. Steel
   c. Fiberglass
   d. All of the above.
3. A fuel vapor emission control system has been installed on all cars made after:
   a. 1969
   b. 1970
   c. 1977
   d. 1980

Answers:

1. a
2. d
3. b

Practical Application:

The student will remove and replace a fuel tank with no fuel leaks.

Method of Evaluating Practical Application:

Use Checklist performance Objective 101 to determine if the assignment was completed with 100 percent accuracy and no fuel leaks.

CHECKLIST FOR PERFORMANCE OBJECTIVE 101 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A FUEL TANK.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Removed fuel from tank.		
2. Disconnected the fuel lines and electrical connections.		
3. Disconnected fuel filter tube.		
4. Supported the fuel tank.		
5. Removed fuel tank attachment hardware and tank.		
6. Transferred components from old tank to replacement tank as necessary.		
7. Installed replacement fuel tank.		
8. Reinstalled attachment hardware and secured.		
9. Reinstalled and secured fuel filter tube.		
10. Reattached and secured fuel lines and electrical connections.		
11. Filled fuel tank and checked for leaks.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 102

TASK: R & R fuel level sending unit.

STANDARD OF PERFORMANCE OF TASK:

Sending unit must be installed in position specified by manufacturer with no leaks and output voltage must be as specified for different fuel levels.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement send unit and gaskets and seals
Fuel syphon and fuel storage canister
Source of compressed air and blow gun.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement sending unit
3. Describe a fuel storage canister
4. Use compressed air.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 128-130.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 128-130.
2. Lecture on the reasons why you would want to replace a fuel level sending unit.
3. Demonstrate how to properly troubleshoot to determine if a sending unit is bad.
4. In a guided learning activity have the students gain access to the fuel tank sending unit.
5. Demonstrate how to properly remove and replace a fuel tank sending unit.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 102

CRITERION-REFERENCED MEASURE:

Questions:

1. What keeps the sending unit from starting a fire in the tank?
   a. Low voltages
   b. High voltages
   c. The sending unit is completely sealed
   d. It is always submerged in fuel.
2. When a fuel tank sending unit float gets fuel soaked, it tends to give a false signal. This signal makes the fuel gauge read:
   a. High
   b. Low
   c. 1/2 tank always
   d. 1/4 tank always.
3. Fuel tank sending units can also tell you when you have other problems such as:
   a. Trash in the fuel
   b. Water in the tank
   c. A hole in the tank
   d. None of the above.

Answers:

1. a
2. b
3. b

Practical Application:

The student will remove and replace a fuel tank sending unit with no fuel leaks and proper output voltages for different fuel levels.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 102 to determine if the assignment was completed with 100 percent accuracy and no fuel leaks and proper voltages for different fuel levels.

CHECKLIST FOR PERFORMANCE OBJECTIVE 102 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A FUEL LEVEL SENDING UNIT.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located sending unit.		
2. Removed components as necessary to gain access to sending unit.		
3. Cleaned sending unit area with compressed air to prevent dirt from entering tank.		
4. Syphoned fuel as necessary to lower fuel level below sending unit opening.		
5. Removed sending unit attachment hardware, fuel lines, electrical connections.		
6. Removed sending unit.		
7. Cleaned sending unit mounting surfaces (Caution: Do not allow dirt to enter tank).		
8. Installed replacement sending unit and necessary gaskets or seals.		
9. Reattached fuel lines and electrical connections.		
10. Checked for gauge reading while filling the tank.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 102 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
11. Checked for fuel leaks.		
12. Reinstalled any components that were removed to gain access.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 103

TASK: R & R fuel injection nozzle (diesel).

STANDARD OF PERFORMANCE OF TASK:

Nozzle must be fully seated; securing clamps must be tight and nozzle must perform according to manufacturer's specifications for fuel pattern and pressure.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Injection nozzle.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement injection nozzle.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 203-205

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 203-205.
2. Lecture on the causes of faculty diesel fuel injection nozzles.
3. Demonstrate how to properly troubleshoot to determine if an injection nozzle is bad.
4. In a guided learning activity have the students gain access to the injectors.
5. Demonstrate how to properly remove and replace a diesel fuel injection nozzle.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 103.

CRITERION-REFERENCED MEASURE:

Questions:

1. When a line is removed to an injector, what must be done afterwards?
   a. Replace the line
   b. Replace the filters
   c. Bleed all the air out of the lines
   d. Drain and reservice the fuel system.
2. Injector nozzles operate on what type of pressure?
   a. High
   b. Low
   c. They are mechanical
   d. None of the above.
3. A diesel fuel injection nozzle injects fuel into:
   a. The head
   b. The cylinder
   c. The prechamber
   d. None of the above.

Answers:

1. c
2. a
3. b

Practical Application:

The student will remove and replace a diesel fuel injection nozzle according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 103 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 103 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A DIESEL FUEL INJECTION NOZZLE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located and gained access to injection nozzle.		
2. Loosened and removed any electrical connections if used.		
3. Loosened and removed fuel lines to nozzle.		
4. Loosened and removed injection nozzle clamp.		
5. Removed injection nozzle according to manufacturer's instructions.		
6. Set replacement nozzle into original's position.		
7. Seated nozzle into position according to manufacturer's instructions.		
8. Installed nozzle clamp and bolt; torqued to manufacturer's specifications.		
9. Reattached injection lines to nozzle.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 103 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
10. Reattached electrical connections.		
11. Reinstalled any parts removed to gain access to nozzle.		
12. Started engine and checked for leaks; corrected as necessary.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 104

TASK: R & R diesel injection line.

STANDARD OF PERFORMANCE OF TASK:

New line must be positioned and routed as the original, with all fuel connections tight and no leakage or seepage.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement line.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement injection line.

RESOURCES:

Crouse,**Automotive Mechanics**, pp. 203-205.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 203-205.
2. Lecture on the problems caused by leaking fuel lines.
3. Demonstrate how to properly troubleshoot to determine where a fuel line is leaking.
4. In a guided learning activity have the students gain access to the fuel line to be replaced.
5. Demonstrate how to properly remove and replace a diesel fuel line.
6. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 104

CRITERION-REFERENCED MEASURE:

Questions:

1. Fuel injection lines are made of:
   a. Steel
   b. Copper
   c. Rubber
   d. Aluminum.
2. When removing an injection line the engine will be:
   a. Off
   b. Running to prevent air from getting in the line
   c. Running, but at idle to keep the pressure down
   d. None of the above.
3. A diesel fuel injection line connects the:
   a. Injector and injector pump
   b. Supply pump and the injector
   c. Supply pump and the injector pump
   d. None of the above.

Answers:

1. a
2. a
3. a

Practical Application:

The student will remove and replace a diesel fuel injection line with no leaks and/or seepage.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 104 to determine if the assignment was completed with 100 percent accuracy with no leaks or seepage.

CHECKLIST FOR PERFORMANCE OBJECTIVE 104 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A DIESEL FUEL INJECTION LINE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located and gained access to injection lines.		
2. Loosened and removed all clamps, brackets, etc. securing lines to engine.		
3. Loosened and disconnected line from injection nozzle.		
4. Loosened and removed line from injection pump.		
5. Removed line from engine.		
6. Positioned new line in original's location.		
7. Connected and tightened line to injection pump.		
8. Connected and tightened line to injection nozzle.		
9. Reinstalled clamps, brackets, etc., securing line to engine.		
10. Bled the injection line.		
11. Replaced parts previously removed to gain access.		
12. Started engine and checked for leaks.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 105

TASK: Bleed diesel fuel system.

STANDARD OF PERFORMANCE OF TASK:

All air must be bled from injection system using procedures specified by manufacturer.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Injection system maintenance manual.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Read repair manual.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 203-205.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics,** pp. 203-205.
2. Lecture on the problems caused by air in the supply lines.
3. In a guided learning activity have the students gain access to the fuel lines to be bled.
4. Demonstrate how to properly bleed a set of injection lines.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 105

CRITERION-REFERENCED MEASURE:

Questions:

1. Air in the injection system:
   a. Compresses too easily and will not allow the system to pressurize
   b. Keeps the injector from working as it should
   c. Can ruin the injector pump
   d. All of the above.
2. Air can get in the system:
   a. Only through the tank
   b. Only around the injectors
   c. Only through the pump
   d. Through any line or fitting.
3. Once air is in the system, what must be done?
   a. The system drained and serviced
   b. All lines opened and bled
   c. The pump removed and replaced
   d. The injectors removed and replaced.

Answers:

1. d
2. d
3. b

Practical Application:

The student will bleed the injector system using procedures specified by the manufacturer.

Method of Evaluating Practical Application.:

Use Checklist Performance Objective 105 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 105 EVALUATION:

PERFORMANCE TEST FOR BLEEDING A DIESEL FUEL SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonalbe time. A score of 100% is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Referred to manufacturer's instructions for system being serviced.		
2. Loosened fuel pump outlet line and cranked engine until fuel flows from connection.		
3. Tightened connection at pump outlet.		
4. Loosened connection at fuel filter outlet.		
5. Cranked engine until fuel flows from connection.		
6. Retightened connection.		
7. Loosened fuel line connections at fuel injectors.		
8. Cranked engine until fuel appears.		
9. Retightened connections.		
10. Started engine and operated for a period of time necessary to purge remaining air from system.		
11. Referred to fuel injection system malfunction diagnosis manual if engine will not start or run.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 106

TASK: R & R diesel fuel filter.

STANDARD OF PERFORMANCE OF TASK:

Fuel filter must be securely mounted in original position with no leakage or seepage and air must be bled from system.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Fuel filter.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement fuel filter.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 203-205.

TEACHING ACTIVITIES:

1. Read and discuss text **Automotive Mechanics**, pp. 203-205.
2. Lecture on the different types of fuel filters.
3. In a guided learning activity have the students gain access to the fuel filter to be replaced.
4. Demonstrate how to properly remove and replace a fuel filter.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 106

CRITERION-REFERENCED MEASURE:

Questions:

1. When a filter becomes clogged:
    a. Take it off and throw it away,
    b. Take it off and punch a hole through it,
    c. Remove and replace it with a like one,
    d. They don't get clogged.
2. It is best to fill the filter up with clean fuel before installing it because:
    a. It will never fill up otherwise,
    b. It helps to reduce air in the system,
    c. You shouldn't. It will fill up after you start it,
    d. It is best to fill it with gasoline.
3. The element inside the fuel filter is made of:
    a. Paper
    b. Steel
    c. Brass
    d. All of the above.

Answers:

1. c
2. b
3. d

Practical Application:

The student will remove and replace a fuel filter with no leakage or seepage and all air must be bled from the system.

Method of Evaluating Practical Application:

Use checklist Performance Objective 106 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 106 EVALUATION:

PERFORMANCE TEST FOR REMOVING AND REPLACING A DIESEL FUEL FILTER.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located and gained access to filter.		
2. Loosened and removed fuel lines at filter.		
3. Loosened and removed brackets, bolts, etc. attaching filter to engine.		
4. Removed filter from engine.		
5. Located new filter in original's position.		
6. Reinstalled attaching bolts and brackets.		
7. Reconnected fuel lines.		
8. Bled air from the system.		
9. Reinstalled parts previously removed to gain access to filter.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE FUEL SYSTEM

PERFORMANCE OBJECTIVE 107

TASK: Remove moisture from water separator.

STANDARD OF PERFORMANCE OF TASK:

All moisture must be removed from water separator reservoir according to manufacturer's procedure.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Describe a water separator.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp. 253-255.

TEACHING ACTIVITIES:

1. Read and discuss text **Auto Mechanics Theory and Service,** pp.253-255.
2. Lecture on the adverse affects of water in the fuel system.
3. In a guided learning activity have the students gain access to the water separator.
4. Demonstrate how to properly remove water from a water separator.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 107

CRITERION-REFERENCED MEASURE:

Questions:

1. Water must be removed from the fuel system to:
   a. Keep rust from forming inside the pump,
   b. Keep the filter from getting wet,
   c. Enable the engine to run,
   d. Prevent the fuel from becoming higher in octane.
2. Water in the fuel may cause:
   a. The injection pump to freeze up,
   b. The injectors to freeze up,
   c. The engine to stop running,
   d. All of the above.
3. Water in the fuel system is separated by:
   a. Coalescing paper
   b. Gravity
   c. Contrifugal force
   d. All of the above.

Answers:

1. c
2. d
3. d

Practical Application:

The student will remove all moisture from a water separator reservoir according to manufacturer's procedure.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 107 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 107 EVALUATION:

PERFORMANCE TEST FOR REMOVING WATER FROM A WATER SEPARATOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Referred to manufacturer's manual as to type of separator being serviced.		
2. Located and gained access to water separator drain.		
3. Opened drain.		
4. Drained contaminants until clean fuel began to exit drain.		
5. Shut off drain.		
6. Loosened attaching bolts and removed water and contaminant reservoir if no drain was provided.		
7. Emptied and cleaned reservoir and reinstalled on separator.		
8. Operated vehicle and checked for leaks.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

MAINTAINING THE EMISSION CONTROL SYSTEM

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 108

TASK: R & R vacuum hose.

STANDARD OF PERFORMANCE OF TASK:

Hose must be correctly routed and secured on the fitting with no vacuum leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Bulk hose
Hose clamp.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a vacuum hose
3. Identify a hose clamp.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp. 452-453.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto mechanics Theory and Service,** pp. 452-453.
2. Lecture on the problems that occur with vacuum hoses.
3. In a guided learning activity have the students gain access to the hoses to be replaced.
4. Demonstrate how to properly remove and replace a vacuum hose.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 108

CRITERION-REFERENCED MEASURE:

Questions:

1. Vacuum hoses usually fail because of:
    a. Cracks
    b. Distortion from chemicals
    c. Heat
    d. All of the above.
2. Vacuum hoses usually carry:
    a. Oil
    b. Water
    c. Gas
    d. None of the above.
3. Vacuum is measured in:
    a. PSI.
    b PSIG.
    c. Negative PSI.
    d. Inches of mercury.

Answers:

1. d
2. d
3. d

Practical Application:

The student will remove and replace a vacuum hose as necessary with no vacuum leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 108 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 108 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING VACUUM HOSE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Gained access to hose.		
2. Removed or loosened clamps, if so equipped.		
3. Removed hose.		
4. Inspected fitting.		
5. Cut new hose to proper length.		
6. Installed hose on fittings and route according to manufacturer's specifications.		
7. Inspected clamps and replaced if necessary.		
8. Tightened hose clamps.		
9. Started engine and checked for leaks.		
10. Replaced any parts that were previously removed.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 109

TASK: R & R PCV valves.

STANDARD OF PERFORMANCE OF TASK:

Valve must be mounted securely with no vacuum leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement PCV kit
Hose clamps (if needed)
Hoses and gaskets (if needed)
PCV valve tester, if available.

ENABLING OBJECTIVES:

1. Use a standard tool kit
2. Use PCV valve tester
3. Identify a replacement PCV valve.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service** , pp. 457-460.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger **Auto Mechanics Theory and Service**, pp. 459-460.
2. Lecture on the reasons to maintain a good working PCV valve system.
3. In a guided learning activity have the students gain access to the PCV valve to be replaced.
4. Demonstrate how to properly remove and replace a PCV valve.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 109

CRITERION-REFERENCED MEASURE:

Questions:

1. A prime indication that a PCV valve had failed would be:
   a. Excessive oil consumption
   b. Engine leaking oil
   c. Engine running hot
   d. All of the above.
2. PCV means?
   a. Pistons, crankshafts and valves
   b. Positive crankcase ventilation
   c. Positive crankshaft ventilation
   d. Pink colored vacuum.
3. PCV Valves should be replaced every:
   a. 10,000 miles
   b. 50,000 miles
   c. 5,000 miles
   d. Time you replace the air filter.

Answers:

1. a
2. b
3. d

Practical Application:

The student will remove and replace a PCV valve with no vacuum leaks.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 109 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 109 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING A PCV VALVE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located PCV valve.		
2. Removed or loosened clamps, if so equipped.		
3. Removed PCV valve.		
4. Inspected mounting gasket or threads.		
5. Inspected attaching hoses for restrictions or softness.		
6. Installed PCV valve in mounting fitting.		
7. Reconnected attaching hoses and tightened clamps, if so equipped.		
8. Started engine and checked for vacuum at PCV filter.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 110

TASK: Adjust idle speed control device.

STANDARD OF PERFORMANCE OF TASK:

Engine must idle at manufacturer's specified soloenoid idle speed.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Tachometer
Manufacturer's specifications for solenoid idle speed.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Use tachometer
3. Read manufacturer's specifications.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 173-174

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 173-174.
2. Lecture on why you should maintain the proper idle speed.
3. In a guided learning activity have the students connect the tachometer to be used and gain access to the solenoid.
4. Demonstrate how to properly set the idle speed solenoid.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 110

CRITERION-REFERENCED MEASURE:

Questions:

1. Idle speed control devices control:
   a. Gas through the idle jets
   b. Air through the idle jets
   c. Gas entering the carburetor
   d. The throttle opening.
2. A tachometer indicates:
   a. Engine fuel flow
   b. Engine speed
   c. Both a and b
   d. None of the above.
3. Idle speed control devices are used to:
   a. Control idle speeds during acceleration
   b. Control idle speeds during deceleration
   c. Absorb power surges from the engine
   d. Control idle speeds while running.

Answers:

1. d
2. b
3. b

Practical Application:

The student will adjust the idle speed solenoid in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 110 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 110 EVALUATION:

PERFORMANCE TEST ADJUSTING IDLE SPEED CONTROL DEVICE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Removed air cleaner.		
2. Connected tachometer.		
3. Started engine.		
4. Turned adjusting screw to obtain manufacturer's specified RPM for solenoid idle.		
5. Disconnected tachometer.		
6. Replaced air cleaner.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 111

TASK: R & R idle speed control device.

STANDARD OF PERFORMANCE OF TASK:

Device must be mounted securely in place and engine must idle at manufacturer's specified solenoid idle speed.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
New idle speed
Tachometer.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a new idle speed control device
3. Use a tachometer.

RESOURCES:

Crouse. **Automotive Mechanics**, pp. 173-174.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics**, pp. 173-174.
2. Lecture on the problems caused by a faulty idle speed control device.
3. In a guided learning activity have the students gain access to the idle speed solenoid.
4. Demonstrate how to properly remove and replace the idle speed solenoid.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 111

CRITERION-REFERENCED MEASURE:

Questions:

1. When removing the idle control device:
   a. The engine should be off
   b. The engine should be running
   c. The engine should be out
   d. The carburetor should be removed.
2. Adjusting the idle speed control will be accomplished with:
   a. The engine cold and running
   b. The carburetor removed and on the bench
   c. The engine warm and running
   d. None of the above.
3. The idle speed control device is:
   a. A mechanical device connected to the distributor
   b. An electrical device connected to the throttle
   c. An electrical device connected to the ignition system
   d. An electro-mechanical device connected to the gas pedal.

Answers:

1. a
2. c
3. b

Practical Application:

The student will remove and replace the idle speed solenoid in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 111 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 111 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING THE IDLE SPEED CONTROL DEVICE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner and other obstructions.		
2. Removed electrical or vacuum connections as appropriate.		
3. Removed idle speed control device from carburetor.		
4. Mounted new device to carburetor.		
5. Started engine.		
6. Adjusted device to specified RPM.		
7. Replaced air cleaner and any other obstructing parts which were removed.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 112

TASK: R & R deceleration valve.

STANDARD OF PERFORMANCE OF TASK:

Deceleration valve must be fastened securely in place and engine deceleration must be in accordance with manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Deceleration valve
Tachometer (if appropriate)
Feeler gauge (if appropriate).

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a deceleration valve
3. Use feeler gauge.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 173-174

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 173-174.
2. Lecture on the problems caused by a faulty deceleration valve.
3. In a guided learning activity have the students gain access to the deceleration valve.
4. Demonstrate how to properly remove and replace the deceleration valve.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 112

CRITERION-REFERENCED MEASURE:

Questions:

1. A deceleration valve:
    a. Controls fuel going into the carburetor
    b. Controls air going into the carburetor
    c. Controls the throttle movement during deceleration
    d. Controls the ignition system during deceleration.
2. When removing the deceleration valve:
    a. The engine should be hot and running
    b. The engine should be cold and running
    c. The carburetor should be removed
    d. The engine should not be running.
3. The deceleration valve:
    a. Helps to control emissions put out by the engine
    b. Keeps the engine from cooling off too quickly
    c. Prevents the carburetor from losing its prime
    d. Prevents the ignition system from over powering the fuel system.

Answers:

1. c
2. d
3. a

Practical Application:

The student will remove and replace the deceleration valve in accordance with manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 112 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 112 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING THE DECELERATION VALVE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner and other obstructions.		
2. Removed vacuum line if so equipped.		
3. Removed deceleration valve.		
4. Secured new deceleration valve in proper position.		
5. Replaced hoses, if so equipped.		
6. Adjusted device to manufacturer's specifications for speed control and point of engagement as required.		
7. Replaced air cleaner and any other obstructing parts which were removed.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 113

TASK: R & R thermostatic air cleaner sensor.

STANDARD OF PERFORMANCE OF TASK:

Sensor must be fastened securely in place with wires or vacuum hoses connected securely.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
New sensor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a thermostatic air cleaner sensor.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 133-135.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp 133-135.
2. Lecture on the reasons to keep a properly functioning thermostatic air cleaner (TAC) sensor.
4. Demonstrate how to properly remove and replace the TAC sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 113

CRITERION-REFERENCED MEASURE:

Questions:

1. The TAC system:
    a. Diverts into the engine during warm-up
    b. Diverts heated air into the intake during warm-up
    c. Diverts heated air to the carburetor during warm-up
    d. Diverts cold air into the intake during acceleration.
2. The TAC sensor is a:
    a. Vacuum operated switch
    b. Temperature sensing spring
    c. Electrically operated valve
    d. None of the above.
3. Where is the TAC sensor mounted?
    a. In the passenger compartment
    b. In the engine compartment
    c. In the breather assembly
    d. On the breather assembly.

Answers:

1. c
2. b
3. c

Practical Application:

The student will remove and replace the Thermostatic Air Cleaner sensor with the sensor fastened and all connections secured.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 113 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 113 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING THE TAC SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner and vacuum hoses or electrical wires.		
2. Removed air sensor by drilling out rivets or other appropriate method.		
3. Attached new sensor in place.		
4. Reconnected vacuum hoses or electrical wires.		
5. Checked sensor operation.		
6. Replaced air cleaner and any other obstructing parts.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 114

TASK: R & R thermostatic air cleaner actuator.

STANDARD OF PERFORMANCE OF TASK:

Vacuum motor must be fastened securely in place and move the door through its full range of movement.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
New vacuum motor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify new vacuum motor.

RESOURCES:

Crouse. **Automotive Mechanics,** pp. 133-135

TEACHING ACTIVITIES:

1. Read and discuss text, **Automotive Mechanics,** pp. 133-135.
2. Lecture on the problems caused by a malfunctioning thermostatic air cleaner (TAC) system.
3. In a guided learning activity have the students gain access to the TAC actuator.
4. Demonstrate how to properly remove and replace the TAC actuator.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 114

CRITERION-REFERENCED MEASURE:

Questions:

1. When the TAC system actuator fails:
   a. The diverter diverts hot air to the engine all the time.
   b. The diverter diverts normal air to the engine all the time.
   c. The diverter stays to the position where broken.
   d. All of the above.
2. The TAC actuator is:
   a. Vacuum operated
   b. Spring operated
   c. Electrically operated
   d. None of the above.
3. Where is the TAC actuator mounted?
   a. In the passenger compartment
   b. In the engine
   c. In the breather horn
   d. On the carburetor.

Answers:

1. d
2. a
3. c

Practical Application:

The student will remove and replace the Thermostatic Air Cleaner actuator and the door must operate full range of movement.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 114 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 114 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING THE TAC ACTUATOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed air cleaner and other obstructing parts.		
2. Disconnected vacuum hose from actuator.		
3. Removed vacuum motor from air cleaner housing.		
4. Attached and secured vacuum motor.		
5. Reconnected vacuum hose.		
6. Checked operation of vacuum motor and door.		
7. Replaced air cleaner and other obstructing parts.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 115

TASK: Clean EGR valve.

STANDARD OF PERFORMANCE OF TASK:

When vacuum is applied to valve at idle speed, engine must stall or idle roughly indicating exhaust gas is recirculating; idle must improve when vacuum is removed.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Gasket
Auxiliary vacuum source.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify new EGR valve gasket
3. Locate an auxiliary vacuum source.

RESOURCES:

Crouse, **Automotive Mechanics,** p. 135.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** p. 135.
2. Lecture on the problems caused by a malfunctioning EGR valve.
3. In a guided learning activity have the students gain access and remove the EGR valve.
4. Demonstrate how to properly clean the EGR valve removed.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 115

CRITERION-REFERENCED MEASURE:

Questions:

1. The EGR valve system helps to reduce emission by:
   a. Allowing exhaust to escape through the valve,
   b. Allowing exhaust to re-enter through the valve,
   c. Allowing cold air to enter through the valve,
   d. None of the above.
2. The EGR valve is located?
   a. In the intake
   b. On the exhaust
   c. At the base of the carburetor
   d. None of the above.
3. The EGR valve is operated by?
   a. Electrical impulses
   b. Hydraulics
   c. Vacuum
   d. Mechanical linkage.

Answers:

1. b
2. c
3. c

Practical Application:

The student will clean the EGR valve according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 115 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 115 EVALUATION:

PERFORMANCE TEST CLEAN AN EGR VALVE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks wtihin a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed EGR valve.		
2. Cleaned valve mounting surface.		
3. Removed carbon deposits from valve orifice being careful not to mar the plate or seat.		
4. Cleaned the valve gasket mating surface.		
5. Reinstalled valve with new gasket.		
6. Operated engine to check valve operation.		
7. Replaced components removed for access.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 116

TASK: R & R EGR valve.

STANDARD OF PERFORMANCE OF TASK:

When vacuum is applied to valve at idle speed, engine must stall or idle roughly indicating exhaust gas is recirculating; idle must improve when vacuum is removed.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement valve and gasket
Auxiliary vacuum source.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a new EGR valve
3. Locate an auxiliary vacuum source.

RESOURCES:

Crouse, **Automotive Mechanics,** p. 135

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** p. 135.
2. Lecture on the need to replace a malfunctioning EGR valve.
3. In a guided learning activity have the students gain access to the EGR valve.
4. Demonstrate how to properly remove and replace the EGR valve.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 116

CRITERION-REFERENCED MEASURE:

Questions:

1. A malfunctioning EGR valve will make an engine run:
   a. Hot
   b. Cold
   c. Rough or not at all
   d. None of the above.
2. When removing an EGR valve it is best to have the car:
   a. Running and hot
   b. Off but hot
   c. Running and cold
   d. Off and cold.
3. How do you test an EGR valve?
   a. With a vacuum pump
   b. With gas
   c. Blow air through it
   d. You can't, just take it off and throw it away.

Answers:

1. c
2. d
3. a

Practical Application:

The student will remove and replace the EGR valve according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 116 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 116 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING EGR VALVE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located EGR valve.		
2. Removed components to gain access to valve.		
3. Disconnected vacuum hoses from valve.		
4. Removed valve.		
5. Cleaned valve mounting surface.		
6. Reinstalled replacement valve and gasket.		
7. Reattached vacuum hose to valve.		
8. Ran engine and checked that valve opens at 2500 RPM and is closed at idle.		
9. Reinstalled components removed to gain access.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 117

TASK: R & R air pump.

STANDARD OF PERFORMANCE OF TASK:

Air pump must be installed according to manufacturer's procedures.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement air pump and gaskets as required.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement air pump.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 372-374.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics**, pp.372-374.
2. Lecture on the problems caused by a faulty air pump.
3. In a guided learning activity have the students gain access to the air pump.
4. Demonstrate how to properly remove and replace the air pump.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 117

CRITERION-REFERENCED MEASURE:

Questions:

1. The air pump:
   a. Injects air into the carburetor
   b. Pumps air from the intake to the cylinders
   c. Injects air into the exhaust
   d. Pumps exhaust into the intake.
2. The air pump is driven from the:
   a. Camshaft
   b. Crankshaft
   c. Distributor
   d. Flywheel.
3. The purpose of the air pump:
   a. Is to cool the exhaust system
   b. Supply air to the engine to make it run faster
   c. Increase the air to gas ratio in the exhaust
   d. Help to cool the radiator down.

Answers:

1. c
2. b
3. c

Practical Application:

The student will remove and replace the air pump according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 117 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 117 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AIR PUMP.

Student's Name Date

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located pump.		
2. Removed components as necessary.		
3. Removed vacuum and air supply hoses.		
4. Loosened belt adjustment and removed belt.		
5. Removed bolts and removed pump.		
6. Transferred belt pulley and other components as required.		
7. Reinstalled replacement pump.		
8. Reinstalled pump drive belt.		
9. Adjusted belt tension and secured pump and belt adjustment.		
10. Reinstalled air supply and vacuum hoses.		
11. Reinstalled components as required.		
12. Checked air pump operation.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 118

TASK: R & R diverter and anti-backfire valve.

STANDARD OF PERFORMANCE OF TASK:

The valve must be installed according to manufacturer's specifications, hoses must be secure with no air or vacuum leaks and the diverter valve functions according to manufacturer's specifications with the engine operating at specified RPM.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement valve
Auxiliary vacuum source
Tachometer.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement air pump.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 364-366.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 364-366.
2. Lecture on the problems caused by a diverter valve.
3. In a guided learning activity have the students gain access to the diverter valve.
4. Demonstrate how to properly remove and replace the diverter valve.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 118

CRITERION-REFERENCED MEASURE:

Questions:

1. The diverter valve:
   a. Diverts air back to the breather,
   b. Diverts exhaust back to the breather,
   c. Diverts air into the exhaust,
   d. Diverts exhaust into the intake.
2. The diverter valve works off of:
   a. Vacuum
   b. Electricity
   c. Pressure
   d. Differential pressure between exhaust and intake.
3. The purpose of the diverter valve is:
   a. To prevent the exhaust from building up too much pressure,
   b. Send plenty of fresh air to the intake during deceleration,
   c. To prevent too much pressure from building up in the pump,
   d. Relieve pressure in both intake and exhaust.

Answers:

1. a
2. a
3. b

Practical Application:

The student will remove and replace the diverter valve according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 118 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 118 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AND ANTI-BACKFIRE DIVERTER VALVE.

Student's Name Date

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonalbe time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located diverter valve.		
2. Removed components as needed for access.		
3. Disconnected vacuum and air flow hoses.		
4. Removed diverter valve and its gasket if so equipped.		
5. Cleaned mounting surfaces.		
6. Installed replacement valve with new gasket.		
7. Reattached vacuum and air hoses.		
8. Tested valve performance with the engine running.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 119

TASK: R & R closed system charcoal canister filter.

STANDARD OF PERFORMANCE OF TASK:

Canister filter must be replaced according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement canister filter.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement canister filter.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 347-349.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 347-349.
2. Lecture on the reasons to keep a properly functioning canister filter.
3. In a guided learning activity have the students gain access to the canister filter.
4. Demonstrate how to properly remove and replace the canister filter.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 119

CRITERION-REFERENCED MEASURE:

Questions:

1. The canister filter has to filter the gas for:
   - a. Foam
   - b. Lava rocks
   - c. Charcoal
   - d. Paper.
2. The canister filter:
   - a. Catches overflow fuel from the tank and carburetor while running,
   - b. Catches fuel vapors from the tank and carburetor while idle,
   - c. Filters fuel going to the carburetor,
   - d. Filters fuel going back to the tank.
3. The canister filter is mounted:
   - a. In the intake,
   - b. In the engine compartment,
   - c. In the gas tank,
   - d. On the gas tank.

Answers:

1. c
2. b
3. b

Practical Application:

The student will remove and replace the canister filter according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 119 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 119 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING A CLOSED SYSTEM CHARCOAL CANISTER FILTER.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located canister filter.		
2. Removed components as needed for access.		
3. Disconnected vapor hoses from canister.		
4. Loosened canister filter out of bottom of canister, where required.		
5. Removed cover from canister bottom.		
6. Slid canister filter out of bottom of canister.		
7. Slid new filter into the bottom of canister positioning it evenly.		
8. Reinstalled the cover and canister.		
9. Reconnected vapor hoses.		
10. Replaced components removed for access.		

APPROVED: YES _____ NO ____

Evaluator's Signature Date

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 120

TASK: R & R catalytic converter.

STANDARD OF PERFORMANCE OF TASK:

The catalytic converter must be installed according to the manufacturer's procedure without leaks or misalignment.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement catalytic converter.

ENABLING OBJECTIVES:

1. Use a standard tool kit
2. Identify a replacement catalytic converter.

RESOURCES:

Crouse, **Automotive Mechanics**, pp. 366-369.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics**, pp. 366-369.
2. Lecture on the reasons to keep a properly functioning catalytic converter.
3. In a guided learning activity have the students gain access to the catalytic converter.
4. Demonstrate how to properly remove and replace a catalytic converter.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 120

CRITERION-REFERENCED MEASURE:

Questions:

1. If a catalytic converter goes bad you should?
   a. Remove it and leave it off, you don't need it,
   b. Remove it and take the inside portion out,
   c. Remove and replace it,
   d. Leave it.
2. The purpose of the catalytic converter is to:
   a. Separate the unburned chemicals in the exhaust,
   b. Finish burning the unburned chemicals in the exhaust,
   c. Give the exhaust a better smell,
   d. None of the above.
3. What type of fuel should be used with a catalytic equipped car?
   a. Regular
   b. Unleaded high test
   c. Unleaded
   d. Both b and c.

Answers:

1. c
2. b
3. d

Practical Application:

The student will remove and replace the catalytic converter according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 120 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 120 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING CATALYTIC CONVERTER.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Raised vehicle.		
2. Removed attaching clamps or bolts which fasten converter to the exhaust system.		
3. Removed the lower heat shield, if so equipped.		
4. Loosened exhaust system hangers behind the converter, if required.		
5. Removed the catalytic converter.		
6. Installed replacement catalytic converter.		
7. Realigned and secured the clamps, bolts and hangers on the exhaust system behind the catalytic converter.		
8. Secured the catalytic converter attaching hardware.		
9. Reattached the catalytic converter low heat shield, as required.		
10. Rechecked the exhaust system alignment.		
11. Lowered the vehicle.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE EMISSION CONTROL SYSTEM

PERFORMANCE OBJECTIVE 121

TASK: R & R beads in the catalytic converter.

STANDARD OF PERFORMANCE OF TASK:

The beads must be installed according to manufacturer's procedures. Access port plug must be installed securely and be leakproof. The outlet pipe must be reinstalled according to manufacturer's specifications for alignment and clamped securely.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Manufacturer's recommended bead removal and installation equipment
Compressed air source
Replacement beads and access plug kit.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Use bead removal and installation equipment
3. Locate replacement beads and access plug kit.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 375-376.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 375-376.
2. Lecture on the reasons to repair a catalytic converter instead of replacing it.
3. In a guided learning activity have the students gain access to the catalytic converter.
4. Demonstrate how to properly remove and replace the catalytic converter beads.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 121

CRITERION-REFERENCED MEASURE:

Questions:

1. What must be done to get the beads out?
   a. Remove the converter and turn it upside down.
   b. Remove the converter and cut it open.
   c. You must have a special tool to get them out.
   d. You can't get them out.
2. How do you get the beads back in?
   a. With a vacuum system.
   b. Turn it up and pour them in.
   c. After removing the top put them in one by one.
   d. None of the above.
3. What would indicate that the converter was bad?
   a. Beads coming out the tail pipe
   b. A "rotten egg" smell coming from the exhaust
   c. High HC, CO and NOx readings
   d. All of the above.

Answers:

1. c
2. a
3. d

Practical Application:

The student will remove and replace the catalytic converter beads according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist performance Objective 121 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 121 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING BEADS IN CATALYTIC CONVERTER.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Raised vehicle.		
2. Remove the access plug in the bottom of the catalytic converter housing.		
3. Attached the manufacturer's specified bead removal equipment.		
4. Connected compressed air source to the equipment.		
5. Operated the equipment to remove the beads.		
6. Removed the outlet pipe from the catalytic converter.		
7. Installed suction equipment on the outlet of the catalytic converter.		
8. Attached the new bead container to the access port on the bottom of the catalytic converter.		
9. Attached the compressed air source to the suction device to draw beads into the catalytic converter.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 121 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
10. With suction device still operating, removed the bead container and installed the replacement access port plug.		
11. Removed the suction device.		
12. Reinstalled the outlet pipe in the converter and secured it.		
13. Lowered the vehicle.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

MAINTAINING THE ELECTRONIC CONTROL SYSTEM

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 122

TASK: R & R electronic control unit.

STANDARD OF PERFORMANCE OF TASK:

Electronic control unit must be secured and wired according to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement electronic control unit.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement electronic control unit.

RESOURCES:

Course, **Automotive Mechanics,** pp. 304-315.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 304-315.
2. Lecture on the advantages of having an electronic control unit.
3. In a guided learning activity have the students gain access to the electronic control unit.
4. Demonstrate how to properly remove and replace the electronic control unit.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 122

CRITERION-REFERENCED MEASURE:

Questions:

1. What is the most damaging factor to the electronic control unit?
   a. High voltages
   b. Low voltages
   c. Rust
   d. Heat.
2. What can help reduce heat build up?
   a. A lower thermostat
   b. A higher thermostat
   c. Heat conductive grease
   d. None of the above.
3. What does the electronic control unit do?
   a. Controls the ignition according to the signals received
   b. Controls the carburetor
   c. Controls the RPMs of the engine
   d. Controls the cam.

Answers:

1. d
2. c
3. a

Practical Application:

The student will remove and replace the electronic control unit according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 122 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 122 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AN ELECTRONIC CONTROL UNIT.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Disconnected the ignition wiring connector from the module of the distributor.		
2. Removed the distributor cap and rotor if unit is inside distributor.		
3. Removed the control unit mounting volts and removed unit from vehicle.		
4. Coated the bottom of the replacement unit with the dielectic lubricant if unit is mounted inside distributor.		
5. Installed the module in place, secured with mounting bolts or screws and reconnected wires.		
6. Replaced distributor rotor and cap if removed.		
7. Reconnected any other connectors which were disconnected.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 123

TASK: R & R electronic pick-up device.

STANDARD OF PERFORMANCE OF TASK:

Electronic pick-up device shall be installed securely with gap and other measurements within manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement electronic pick-up device.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement electronic pick-up device.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 304-315.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 304-315.
2. Lecture on the problems associated with an electronic pick-up device.
3. In a guided learning activity have the students gain access to the electronic pick-up device.
4. Demonstrate how to properly remove and replace the electronic pick-up device.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 123

CRITERION-REFERENCED MEASURE:

Questions:

1. Where is the electronic pick-up device located?
   a. On the cam
   b. On the crankshaft
   c. In the carburetor
   d. In the distributor.
2. Where does it get its signal from?
   a. The oxygen sensor
   b. The fuel sensor
   c. The central processor
   d. The driver.
3. Why does it need input from another source?
   a. To know when to fire for each cylinder
   b. To know when to cut off
   c. To know when to cut out a cylinder
   d. To know when to alarm.

Answers:

1. d
2. c
3. a

Practical Application:

The student will remove and replace the electronic pick-up device according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 123 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 123 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AN ELECTRONIC PICK-UP DEVICE.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Removed distributor cap and rotor.		
2. Removed the other internal distributor parts to gain access to pick-up device.		
3. Disconnected screws and wires and removed the pick-up device from distributor.		
4. Installed new pick-up device and connected wires.		
5. Adjusted air gap of the installed pick-up device according to manufacturer's specifications.		
6. Replaced any parts removed to gain access.		
7. Replaced distributor cap and rotor.		
8. Started engine and checked operation.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 124

TASK: R & R exhaust oxygen sensor.

STANDARD OF PERFORMANCE OF TASK:

Oxygen sensor must be mounted and wired according to manufacturer's procedures.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement oxygen sensor
Anti-seize compound as specified by manufacturer.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement oxygen sensor
3. Describe anti-seize compound.

RESOURCES:

1. deKryger, et al., **Auto Mechanics Theory and Service**, pp. 408-418

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, pp. 408-418.
2. Lecture on the problems associated with oxygen sensor.
3. In a guided learning activity have the students gain access to the oxygen sensor.
4. Demonstrate how to properly remove and replace the oxygen sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 124

CRITERION-REFERENCED MEASURE:

Questions:

1. What does the oxygen sensor do?
    a. Senses oxygen in the combustion chamber
    b. Senses oxygen in the carburetor
    c. Senses oxygen in the exhaust
    d. None of the above.
2. Where is the oxygen sensor located?
    a. In the head
    b. In the intake
    c. In the exhaust
    d. In the car.
3. The sensor sends the signal to:
    a. The carburetor
    b. The distributor
    c. The computer
    d. The driver.

Answers:

1. c
2. c
3. c

Practical Application:

The student will remove and replace the oxygen sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 124 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 124 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AN EXHAUST OXYGEN SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located oxygen sensor.		
2. Removed air cleaner and other obstructions.		
3. Disconnected battery.		
4. Removed electrical leads from sensor.		
5. Unscrewed the sensor from the exhaust manifold.		
6. Coated the treads of the replacement sensor with the special conductive anti-seize compound.		
7. Screwed the replacement sensor into place and torqued to manufacturer's specifications.		
8. Replaced electrical leads on sensor.		
9/. Reconnected battery and replaced any components removed		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 125

TASK: R & R electronic spark/timing module.

STANDARD OF PERFORMANCE OF TASK:

Spark/timing module must be mounted and wired according to manufacturer's procedures and specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement electronic spark/timing module.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement electronic spark/timing module.

RESOURCES:

deKryger, et at., **Auto Mechanics Theory and Service**, pp. 368-369.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, pp. 368-369.
2. Lecture on the problems associated with electronic spark/timing module.
3. In a guided learning activity have the students gain access to the electronic spark/timing module.
4. Demonstrate how to properly remove and replace the electronic spark/timing module.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 125

CRITERION-REFERENCED MEASURE:

Questions:

1. The electronic spark/timing module takes the place of what unit?
   a. Distributor
   b. Distributor cap and rotor
   c. Vacuum and centrifugal unit
   d. Electronic module.
2. The electronic spark/timing module can make adjustments:
   a. For each individual cylinder
   b. Only for the engine (all at once)
   c. For the carburetor
   d. None of the above.
3. The electronic spark/timing module is in:
   a. The carburetor
   b. The distributor
   c. The computer
   d. The driver.

Answers:

1. c
2. a
3. b

Practical Application:

The student will remove and replace the electronic spark/timing module according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 125 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 125 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AN ELECTRONIC SPARK/TIMING MODULE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Disconnected battery.		
2. Removed and tagged all wires and connectors to module.		
3. Removed screws from other mounting devices holding module in place.		
4. Removed module from vehicle.		
5. Installed replacement module and secured with screws or other mounting devices.		
6. Reconnected all wires and connectors and reconnected battery.		
7. Started engine, allowed to warm up, and checked operation of module.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 126

TASK: R & R barometric pressure sensor.

STANDARD OF PERFORMANCE OF TASK:

Barometric sensor must be installed according to manufacturer's procedures and provide output voltage in accordance with manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement barometric sensor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement barometric sensor.

RESOURCES:

deKryger,.et al., **Auto Mechanics Theory and Service**, pp. 230-242.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, pp. 230-242.
2. Lecture on why you should keep a properly functioning barometric sensor.
3. In a guided learning activity have the students gain access to the barometric sensor.
4. Demonstrate how to properly remove and replace the barometric sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 126

CRITERION-REFERENCED MEASURE:

Questions:

1. The barometric sensor indicates:
    a. Atmospheric pressure
    b. Cylinder pressure
    c. Vacuum
    d. Cabin pressure.
2. Barometric pressure at sea level on a normal day is:
    a. 14.9 psi.
    b. 14.7 psi.
    c. 14.5 psi.
    d. 29.9 psi.
3. What system is the barometric sensor in?
    a. Fuel
    b. Electrical
    c. Suspension
    d. Air conditioning.

Answers:

1. a
2. b
3. a

Practical Application:

The student will remove and replace the barometric sensor module according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 126 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 126 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING A BAROMETRIC SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located sensor.		
2. Removed parts as necessary to gain access.		
3. Disconnected sensor wiring.		
4. Removed sensor.		
5. Cleaned sensor mounting area.		
6. Installed replacement sensor and secured in place.		
7. Replaced any parts removed to gain access.		
8. Tested sensor output per manufacturer's specifications.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 127

TASK: R & R manifold absolute pressure sensor.

STANDARD OF PERFORMANCE OF TASK:

Sensor must be installed according to manufacturer's procedures and produce output signal in accordance with manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement sensor.

ENABLING OBJECTIVES:

1. Use a standard tool kit
2. Identify replacement absolute pressure sensor.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp. 230-242.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service,** pp. 230-242.
2. Lecture on the problems associated with a malfunctioning absolute pressure sensor.
3. In a guided learning activity have the students gain access to the pressure sensor.
4. Demonstrate how to properly remove and replace the absolute pressure sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 127

CRITERION-REFERENCED MEASURE:

Questions:

1. The absolute pressure sensor reads:
   a. PSIG
   b. PSI.
   c. APSI.
   d. None of the above.
2. Absolute pressure is pressure gained plus:
   a. Barometric pressure
   b. Head pressure
   c. Manifold pressure
   d. Exhaust pressure.
3. In what system is the absolute pressure sensor?
   a. Fuel
   b. Electrical
   c. Suspension
   d. Air conditioning.

Answers:

1. c
2. a
3. a

Practical Application:

The student will remove and replace the absolute pressure sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 127 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 127 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING MANIFOLD ABSOLUTE PRESSURE SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located pressure sensor.		
2. Removed any components as necessary to gain access.		
3. Disconnected sensor wiring.		
4. Removed sensor.		
5. Installed replacement sensor and secured in place.		
6. Reattached sensor wiring.		
7. Reinstalled any components removed to gain access.		
8. Tested function of sensor as per manufacturer's specifications.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 128

TASK: R & R ambient air temperature sensor.

STANDARD OF PERFORMANCE OF TASK:

Sensor must be installed according to manufacturer's procedures and temperature output must be in accordance with manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement sensor.

ENABLING OBJECTIVES:

1. Use a standard tool kit
2. Identify replacement ambient temperature sensor.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 182-183.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 182-183.
2. Lecture on the problems associated with an ambient air temperature sensor.
3. In a guided learning activity have the students gain access to the ambient temperature sensor.
4. Demonstrate how to properly remove and replace the ambient temperature sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 128

CRITERION-REFERENCED MEASURE:

Questions:

1. The ambient air temperature sensor senses:
   a. Outside air temperature
   b. Inside air temperature
   c. Exhaust air temperature
   d. Temperature inside the car.
2. The ambient air temperature sensor is mounted in:
   a. The tail pipe
   b. The intake manifold
   c. Cylinder head
   d. Intake housing.
3. In what system is the ambient air sensor?
   a. Fuel
   b. Electrical
   c. Suspension
   d. Air conditioning.

Answers:

1. a
2. d
3. a

Practical Application:

The student will remove and replace the ambient air temperature sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 128 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 128 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AN AMBIENT AIR TEMPERATURE SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located device.		
2. Removed any components as necessary to gain access.		
3. Disconnected sensor wiring.		
4. Removed sensor from engine.		
5. Mounted replacement sensor in place and secured.		
6. Reattached sensor wiring.		
7. Reinstalled any components removed to gain access.		
8. Tested function of sensor as per manufacturer's specifications.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 129

TASK: R & R coolant temperature sensor.

STANDARD OF PERFORMANCE OF TASK:

Temperature sensor must be installed according to manufacturer's procedures without leaks.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Coolant drain pan
Replacement coolant temperature sensor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a coolant drain pan
3. Identify a replacement coolant temperature sensor.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 231-232.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 231-232.
2. Lecture on why you should maintain a good working coolant indicating system.
3. In a guided learning activity have the students gain access to the coolant temperature sensor.
4. Demonstrate how to properly remove and replace the coolant temperature sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 129

CRITERION-REFERENCED MEASURE:

Questions:

1. The coolant temperature sensor senses:
    a. Engine block temperature
    b. Water temperature
    c. Both a and b
    d. Neither a nor b.
2. The coolant temperature sensor is normally mounted in:
    a. The tail pipe
    b. The intake manifold
    c. Cylinder head
    d. The water pump.
3. The sensor sends a signal to:
    a. A gauge
    b. A computer
    c. Fuel system
    d. All of the above.

Answers:

1. c
2. c
3. d

Practical Application:

The student will remove and replace the coolant temperature sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use checklist Performance Objective 129 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 129 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING A COOLANT TEMPERATURE SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located device.		
2. Removed any components as necessary to gain access.		
3. Drained off coolant below sensor level.		
4. Removed sensor wiring.		
5. Removed sensor from radiator, housing or engine block.		
6. Installed replacement sensor and secured in place.		
7. Applied appropriate sealer per manufacturer's specifications.		
8. Reattached sensor wiring.		
9. Replaced engine coolant.		
10. Reinstalled components removed for access as necessary.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 129 EVALUATION:

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
11. Started engine, stabilized coolant level, and refilled as required.		
12. Tested function of sensor to manufacturer's specifications.		
13. Checked for leaks.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 130

TASK: Adjust throttle position sensor.

STANDARD OF PERFORMANCE OF TASK:

Throttle position sensor must be adjusted to manufacturer's specifications.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Special tools as required by manufacturer.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Use special tools needed to adjust the sensor.

RESOURCES:

Crouse, **Automotive Mechanics,** pp. 183-184.

TEACHING ACTIVITIES:

1. Read and discuss text Crouse, **Automotive Mechanics,** pp. 183-184.
2. Lecture on the problems caused by an improperly adjusted throttle position sensor.
3. In a guided learning activity have the students gain access to the throttle position sensor.
4. Demonstrate how to properly adjust the throttle position sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 130

CRITERION-REFERENCED MEASURE:

Questions:

1. The throttle position sensor is mounted:
   a. On the throttle body of the carburetor
   b. On the throttle linkage of the fuel injection
   c. Both a and b
   d. Neither a nor b.
2. The throttle position sensor sends a signal to:
   a. The central computer
   b. The driver
   c. The clock
   d. The fuel sender.
3. The sensor is:
   a. Mechanical
   b. Electrical
   c. Electro/mechanical
   d. Hydraulic.

Answers:

1. c
2. a
3. c

Practical Application:

The student will adjust the throttle position sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 130 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 130 EVALUATION:

PERFORMANCE TEST ADJUSTING THE THROTTLE POSITION SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located device.		
2. Determined adjustment method as per manufacturer's specifications.		
3. Loosened adjustment locking mechanism.		
4. Adjusted sensor to manufacturer's specifications.		
5. Tightened adjustment locking mechanism.		
6. Rechecked that adjustment was within specifications.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 131

TASK: R & R engine speed sensor.

STANDARD OF PERFORMANCE OF TASK:

Sensor must be installed according to manufacturer's procedures.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement sensor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement sensor.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp. 232-234

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service,** pp. 232-234.
2. Lecture on why it is necessary to sense RPM in the electronic control system.
3. In a guided learning activity have the students gain access to the engine speed sensor.
4. Demonstrate how to properly remove and replace the engine speed sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 131

CRITERION-REFERENCED MEASURE:

Questions:

1. What kind of indication does the speed sensor send:
    a. Mechanical
    b. Electrical
    c. Hydraulic
    d. None of the above.
2. Engine speed is indicated in:
    a. RPM
    b. PSI
    c. PPM
    d. MMPI.
3. The sensor indicates the speed of the:
    a. Crankshaft
    b. Camshaft
    c. Distributor
    d. Fan.

Answers:

1. b
2. a
3. a

Practical Application:

The student will remove and replace the engine speed sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use the Checklist Performance Objective 131 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 131 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING AN ENGINE SPEED SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located device.		
2. Removed components to gain access as necessary.		
3. Disconnected sensor wiring.		
4. Removed sensor.		
5. Reinstalled replacement sensor.		
6. Reattached sensor wiring.		
7. Reinstalled any components removed for access as required.		
8. Tested sensor output and compared to manufacturer's specifications.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 132

TASK: R & R road speed sensor.

STANDARD OF PERFORMANCE OF TASK:

Road speed sensor must be installed in accordance with manufacturer's procedures.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement sensor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify replacement sensor.

RESOURCES:

deKryger,et al., **Auto Mechanics Theory and Service,** pp. 387-388.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service,** pp. 387-388.
2. Lecture on the problems that plague a speed sensor.
3. In a guided learning activity have the students gain access to the road speed sensor.
4. Demonstrate how to properly remove and replace the road speed sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 132

CRITERION-REFERENCED MEASURE:

Questions:

1. What kind of sensor is the speed sensor?
    a. Mechanical
    b. Electrical
    c. Hydraulic
    d. Electro/mechanical.
2. The speed sensor indicates:
    a. The speed of the car
    b. The speed of the engine.
    c. The speed of the fan
    d. None of the above.
3. The sensor sends a signal to the:
    a. Speedometer
    b. Cruise control
    c. Computer
    d. All of the above.

Answers:

1. d
2. a
3. d

Practical Application:

The student will remove and replace the road speed sensor according to manufacturer's specifications.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 132 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 132 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING A ROAD SPEED SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located device.		
2. Removed components to gain access as necessary.		
3. Disconnected sensor wiring.		
4. Disconnected sensor from speedometer cable as appropriate.		
5. Installed replacement sensor and tightened connections to speedometer cable.		
6. Reattached sensor wiring.		
7. Reinstalled any components removed for access as required.		
8. Tested sensor output and compared to manufacturer's specifications.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 133

TASK: Adjust neutral/park position sensor.

STANDARD OF PERFORMANCE OF TASK:

Starter must operate only in neutral and park positions of shifter handle.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
List of manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Read manufacturer's specifications.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service**, pp. 313-314.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service,** pp.313-314.
2. Lecture on why you should keep the neutral/park position sensor working properly.
3. In a guided learning activity have the students gain access to the neutral safety sensor.
4. Demonstrate how to properly adjust a neutral/park position sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 133

CRITERION-REFERENCED MEASURE:

Questions:

1. What does the neutral/park sensor do?
   a. Keeps the car running while in neutral/park
   b. Keeps the car from starting while in neutral/park
   c. Keeps the car from starting unless in neutral/park
   d. None of the above.
2. The neutral/park sensor works off of the:
   a. Key switch
   b. Driveshaft
   c. Transmission linkage
   d. All of the above.
3. How does the sensor work?
   a. When actuated it completes the circuit
   b. When actuated it breaks the circuit
   c. When actuated it sends a signal to the starter
   d. When actuated it sends a signal to the driver.

Answers:

1. c
2. c
3. a

Practical Application:

The student will adjust the neutral/park position sensor so the starter will operate only in neutral and park.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 133 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 133 EVALUATION:

PERFORMANCE TEST ADJUSTING A NEUTRAL/PARK POSITION SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Located device.		
2. Removed components to gain access as necessary.		
3. Loosened sensor adjustment locking mechanism.		
4. Adjusted sensor per manufacturer's procedure so starter is activated only in neutral or park.		
5. Tightened sensor adjustment locking mechanism.		
6. Rechecked adjustment by attempting to start engine in drive, low and reverse.		
7. Reinstalled components as necessary which were removed for access.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY: MAINTAINING THE ELECTRONIC CONTROL SYSTEM

PERFORMANCE OBJECTIVE 134

TASK: R & R anti-detonation sensor.

STANDARD OF PERFORMANCE OF TASK:

Sensor must be installed and adjusted according to manufacturer's procedures.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Standard tool kit
Replacement sensor.

ENABLING OBJECTIVES:

1. Use standard tool kit
2. Identify a replacement sensor.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service,** pp. 360-362.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service,** pp. 360-362.
2. Lecture on the problems caused by detonation.
3. In a guided learning activity have the students gain access to the detonation sensor.
4. Demonstrate how to properly remove and replace the detonation sensor.
5. Students will complete the performance checklist included in this lesson.

PERFORMANCE OBJECTIVE 134

CRITERION-REFERENCED MEASURE:

Questions:

1. What is detonation?
   a. The premature firing of gas in a cylinder
   b. The ignition of gas after ignition takes place
   c. When fuel does not have enough octane to run
   d. None of the above.
2. The detonation sensor senses:
   a. RPM
   b. EGR
   c. Vibration
   d. Heat.
3. What does the sensor do to compensate?
   a. Sends a signal to lean the carburetor
   b. Sends a signal to retard timing
   c. Sends a signal to advance timing
   d. Sends a signal to quit vibrating.

Answers:

1. b
2. c
3. b

Practical Application:

The student will remove and replace the detonation sensor according to manufacturer's procedures.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 134 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 134 EVALUATION:

PERFORMANCE TEST REMOVING AND REPLACING ANTI-DETONATION SENSOR.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	**RATING**	
	Satisfactory	**Unsatisfactory**
1. Located device.		
2. Removed components to gain access as necessary.		
3. Disconnected sensor wiring.		
4. Removed sensor.		
5. Installed replacement sensor.		
6. Reattached sensor wiring.		
7. Reinstalled components as necessary which were removed for access.		
8. Tested function of sensor to manufacturer's specifications.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

CONDUCTING SHOP OPERATIONS

DUTY: CONDUCTING SHOP OPERATIONS

PERFORMANCE OBJECTIVE 135

TASK: Estimate time and cost for a job.

STANDARD OF PERFORMANCE OF TASK:

All elements of the job must have been identified and correctly looked up in flat rate manual, and all parts must be identified and costed without error.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Labor time guide
Parts manual
Job cost form.

ENABLING OBJECTIVES:

1. Read labor time guide
2. Read a parts manual
3. Complete job cost form.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service**, pp. 24-31.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, pp. 24-31.
2. Lecture on the need for logged time accounting.
3. In a guided learning activity have the students look up the time allowed for a specific job.
4. Demonstrate how to properly account for parts and time for all work performed.
5. Students will complete the performance objective included in this lesson.

PERFORMANCE OBJECTIVE 135

CRITERION-REFERENCED MEASURE:

Questions:

1. How does a time guide help you in figuring cost?
   a. By telling you how much time you take
   b. By keeping the time for you
   c. By listing an average time it takes to do a job
   d. None of the above.
2. What must be taken into consideration when figuring a bill?
   a. Time to do the job
   b. Cost of parts
   c. Hourly rate
   d. All of the above.
3. Which of the following would be the most advantageous when figuring a bill?
   a. Math
   b. English
   c. The ability to read and write
   d. All of the above.

Answers:

1. c
2. d
3. d

Practical Application:

The student will estimate time and cost for a job, taking into account all parts and cost.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 135 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 135 EVALUATION:

PERFORMANCE TEST ESTIMATING THE TIME AND COST OF A JOB.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Listed all tasks or elements of the job which must be done.		
2. Looked up all tasks in the labor time guide.		
3. Added up the total time required and multiplied by the standard hourly rate for the shop.		
4. Listed all parts required (including fluids) and looked up part numbers.		
5. Looked up costs for each part and obtained total for entire job.		
6. Added parts and labor costs to obtain total cost.		
7. Rechecked steps 1. through 6.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: CONDUCTING SHOP OPERATIONS

PERFORMANCE OBJECTIVE 136

TASK: Complete work order form.

STANDARD OF PERFORMANCE OF TASK:

All required information must be recorded on work order form without error.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Work order form.

ENABLING OBJECTIVES:

1. Complete an order form
2. Complete an estimate form.

RESOURCES:

deKryger, et at.,. **Auto Mechanics Theory and Service,** pp. 24-31

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service,** pp. 24-31.
2. Lecture on the necessity to keep good records when working on someone's vehicle.
3. In a guided learning activity have the students retrieve all the information on the work order form.
4. Demonstrate how to properly complete a work order form.
5. Students will complete the performance objective included in this lesson.

PERFORMANCE OBJECTIVE 136

CRITERION-REFERENCED MEASURE:

Questions:

1. When filling out a work order form you should:
    a. Be precise in the description of work to be done
    b. Make sure you charge only for the work completed
    c. List all parts put on the car
    d. All of the above.
2. When should you call a customer about a work order?
    a. To find out when they are going to pay
    b. To find out the cost of parts
    c. If the cost is going to exceed a specified amount
    d. When the work is started.
3. What is the basic thing you need on a work order?
    a. The customer's name
    b. The vehicle information
    c. A description of what is to be done
    d. All of the above.

Answers:

1. d
2. c
3. d

Practical Application:

The student will complete a work order form accounting for all work being done.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 136 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 136 EVALUATION:

PERFORMANCE TEST COMPLETING A WORK ORDER FORM

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Discussed work needed with customer; made diagnosis if necessary.		
2. Filled in customer's name ,address and telephone number.		
3. Filled in vehicle data including make, model, year, identification number.		
4. Wrote in a description of the work to be done.		
5. Obtained customer's signature authorizing work.		
6. Estimated time when job will be completed.		
7. Estimated cost if necessary.		
8. Placed work order form in rack of jobs to be done.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY: CONDUCTING SHOP OPERATIONS

PERFORMANCE OBJECTIVE 137

TASK: Update service manual file.

STANDARD OF PERFORMANCE OF TASK:

All new pages or pen-and-ink changes must be entered in their correct locations without error.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Service manual
New page and/or description of changes to be made.

ENABLING OBJECTIVES:

1. Read a service manual
2. Insert the new changes.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service , PP. 24-31.**

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, pp. 24-31.
2. Lecture on the necessity to keep good updates on service manuals.
3. In a guided learning activity have the students locate the manuals to receive changes.
4. Demonstrate how to properly update a service manual.
5. Students will complete the performance objective included in this lesson.

PERFORMANCE OBJECTIVE 137

CRITERION-REFERENCED MEASURE:

Questions:

1. When updating service manuals, changes are made by:
    a. Pen-and-ink
    b. New pages
    c. Both a and b
    d. Neither a nor b
3. When should you update a service manual?
    a. Once a year
    b. Once every five years
    c. When needed
    d. They don't need updating.
3. Service manuals should be:
    a. Kept clean and serviceable
    b. Near the work area
    c. On all vehicles being worked on
    d. All of the above.

Answers:

1. c
2. c
3. d

Practical Application:

The student will update a service manual without error.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 137 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 137 EVALUATION:

PERFORMANCE TEST UPDATING SERVICE MANUAL FILES.

Student's Name Date

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention the items to be evaluated Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Examined all new pages or changes.		
2. Inserted new pages, one at a time, in place of the old pages.		
3. Made any pen-and-ink changes on existing pages as required.		
4. Destroyed old pages which were replaced.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY: CONDUCTING SHOP OPERATIONS

PERFORMANCE OBJECTIVE 138

TASK: Schedule customer appointments.

STANDARD OF PERFORMANCE OF TASK:

Job must be scheduled with a minimum of lost shop time and a minimum wait for the customer.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Flat rate manual.

ENABLING OBJECTIVES:

1. Read flat rate manual.
2. Tell time.

RESOURCES:

deKryger, et al., **Auto Mechanics Theory and Service**, pp. 24-31.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, , pp 24-31.
2. Lecture on the necessity to keep good updates on service manuals.
3. In a guided learning activity have the student identify the cars to be worked on and what is to be done.
4. Demonstrate how to properly set up a schedule for customer appointments.
5. Students will complete the performance objective included in this lesson.

PERFORMANCE OBJECTIVE 138

CRITERION-REFERENCED MEASURE:

Questions:

1. When scheduling appointments you should never:
   a. Schedule more than eight hours work for one person,
   b. Take one customer over another,
   c. Schedule an appointment for over fifteen minutes,
   d. Put more than one person on a job.
2. When scheduling you should:
   a. Never promise an exact time to finished,
   b. Try to work around the customers schedule,
   c. Try to get the customer in as quickly as possible,
   d. All of the above.
3. When setting up a schedule for a day:
   a. Schedule for every minute of the day,
   b. Stagger lunch hours,
   c. Leave some time for emergencies,
   d. Make appointments only on that day.

Answers:

1. a
2. d
3. c

Practical Application:

The student will schedule customer appointments with a minimum of wait and wasted time.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 138 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 138 EVALUATION:

PERFORMANCE TEST SCHEDULE CUSTOMER APPOINTMENTS.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by he instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Estimator used flat rate manual to determine amount of time required for the job.		
2. Determined whether parts are available or must be ordered.		
3. Examined schedule of other jobs to be performed.		
4. Estimated man-hours available in light of other jobs.		
5. Determined when job to be scheduled can fit in among other jobs.		
6. Marked in job on scheduling form.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

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DUTY: CONDUCTING SHOP OPERATIONS

PERFORMANCE OBJECTIVE 139

TASK: Schedule outside shop work.

STANDARD OF PERFORMANCE OF TASK:

Job must be delivered to and received from specialty shop as scheduled.

SOURCE OF STANDARD:

Writing Team, State of Pennsylvania.

CONDITIONS FOR PERFORMANCE OF TASK:

Telephone.

ENABLING OBJECTIVES:

1. Use a telephone
2. Read a list of outside shops.

RESOURCES:

deKryger, **Auto Mechanics Theory and Service**, pp. 24-31.

TEACHING ACTIVITIES:

1. Read and discuss text deKryger, **Auto Mechanics Theory and Service**, pp. 24-31.
2. Lecture on why it may be necessary to send work out instead of trying it in the shop.
3. In a guided learning activity have the students identify the type of work that might not be handled in every shop.
4. Demonstrate how to properly set up a schedule for work to be completed outside the shop.
5. Students will complete the performance objective included in this lesson.

PERFORMANCE OBJECTIVE 139

CRITERION-REFERENCED MEASURE:

Questions:

1. When scheduling outside work be sure to get:
   a. When they expect to be finished
   b. How much it will cost
   c. Do they stand behind their work
   d. All of the above.
2. How should outside work be scheduled?
   a. Call the customer, then the outside shop
   b. Call the outside, then the inside shop
   c. Tell the customer to bring it in then call the shop
   d. Have the customer bring it in and get it when you can.
3. In order to get the car to the other shop:
   a. Have the customer take it straight to the other shop
   b. Take it on your lunch hour
   c. Wait until you have three or more to go before you take the car
   d. Take it as soon as possible.

Answers:

1. d
2. a
3. d

Practical Application:

The student will schedule outside work and ensure both pick-up and delivery.

Method of Evaluating Practical Application:

Use Checklist Performance Objective 139 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE 139 EVALUATION:

PERFORMANCE TEST SCHEDULE OUTSIDE SHOP WORK.

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Examined workpiece requiring outside shop work.		
2. Telephoned shop and described work required; received estimated time of completion.		
3. Telephoned customer and determined whether schedule was satisfactory or if another alternative was preferred.		
4. Telephoned specially shop and confirmed scheduled; delivered workpiece.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

APPENDICES

APPENDIX A

CROSS-REFERENCE TABLE OF DUTIES, TASKS AND PERFORMANCE OBJECTIVES

APPENDIX A

CROSS REFERENCE TABLE OF DUTIES AND TASKS

	DUTY/TASK	TASK/PAGE NUMBER	PERCENT PERFORMING
A.	**Diagnosing Engine Performance Problems**		
01	Identify causes of engine run-on or dieseling	1/5	100
02	Identify causes of detonation or pre-ignitions.	2/8	98
03	Identify causes of stalling or rough idle when engine is cold.	3/11	100
04	Identify causes of stalling or rough idle when engine reaches operating temperature.	4/14	98
05	Identify causes of stalling or rough idle when engine is at normal operating temperature.	5/17	100
06	Identify causes of engine stumble on acceleration.	6/20	98
07	Identify cause of engine surge at steady throttle.	7/23	96
08	Identify cause of sluggish acceleration.	8/26	100
09	Identify cause of intermittent cutting out.	9/29	96
10	Identify cause of excessive fuel consumption.	10/32	96
11	Identify cause of hard-starting engine (engine turns over).	11/35	100
12	Identify cause of non-starting engine (does not turn over).	12/38	100
13	Identify cause of engine miss.	13/41	100
B.	**Diagnosing Ignition System Problems**		
01	Inspect distributor cap and rotor.	14/45	100
02	Inspect distributor for worn mechanical components.	15/48	98
03	Inspect distributor for malfunctioning electrical components.	16/51	96
04	Test automatic spark advance/retard mechanism operation.	17/54	98
05	Test primary ignition circuit.	18/57	96
06	Test ignition coil.	19/60	93
07	Inspect condition of spark plug and secondary coil wire.	20/63	100
08	Test resistance of spark plug wires.	21/66	96
09	Test glow plug electrical system.	22/69	29
10	Test glow plug.	23/72	29
11	Test primary ignition resistor and resistor by-pass.	24/75	82

	DUTY/TASK	TASK/PAGE NUMBER	PERCENT PERFORMING
C.	**Diagnosing Fuel System Problems**		
01	Inspect carburetor linkage for binding or worn parts.	25/79	100
02	Check for vacuum leaks.	26/82	100
03	Check carburetor air filter.	27/85	100
04	Check anti-dieseling devices.	28/88	93
05	Check accelerator pump operation.	29/91	98
06	Check fuel supply to carburetor.	30/94	100
07	Test electric fuel pump operation.	31/97	93
08	Test mechanical fuel pump operation.	32/100	98
09	Test mechanical fuel injection system.	33/103	42
10	Test electric fuel injection system.	34/106	62
11	Test throttle body fuel injection system.	35/109	62
12	Test diesel fuel injection system.	36/112	24
D.	**Diagnosing Mechanically-Related Performance Problems**		
01	Check for brake dragging.	37/116	100
02	Check for restricted exhaust.	38/119	100
03	Check for clutch/transmission slippage.	39/122	98
04	Check for internal engine wear.	40/125	93
E.	**Diagnosing Emission Control System Problems**		
01	Test PCV system.	41/129	98
02	Check idle speed control system.	42/132	98
03	Check operation of preheated air intake.	43/135	87
04	Check exhaust gas recirculation system.	44/138	98
05	Check air pump.	45/141	98
06	Test electronic fuel mixture control system.	46/144	82
07	Check operation of vacuum operated exhaust manifold heat control valve.	47/147	84
F.	**Diagnosing Electronic Control System**		
01	Test Electronic control unit and wiring harness.	48/151	93
02	Test electronic pick-up device.	49/154	91
03	Test exhaust oxygen sensor.	50/157	73
04	Test spark and timing control module.	51/160	84
05	Test barometric pressure sensor.	52/163	58
06	Test manifold absolute-pressure sensor.	53/166	60
07	Test ambient air temperature sensor.	54/169	71
08	Check coolant temperature sensor.	55/172	89
09	Test throttle position sensor.	56/175	87
10	Test engine speed sensor.	57/178	76
11	Test road speed sensor.	58/181	58
12	Test neutral/park position sensor.	59/184	73
13	Test anti-detonation sensor.	60/187	58

		DUTY/TASK	TASK/PAGE NUMBER	PERCENT PERFORMING
G.		**Maintaining the Ignition**		
	01	Adjust dwell of contact points.	61/191	100
	02	R & R distributor cap.	62/194	100
	03	R & R distributor rotor.	63/197	100
	04	R & R contact points.	64/200	100
	05	R & R condenser.	65/203	100
	06	R & R distributor.	66/206	98
	07	R & R spark advance/retard assembly.	67/209	96
	08	Adjust ignition timing.	68/212	100
	09	R & R ignition coil.	69/215	98
	10	R & R spark plug wires.	70/218	98
	11	R & R spark plugs.	71/221	100
	12	Clean spark plug.	72/224	93
	13	R & R glow plug.	73/227	31
	14	R & R ignition system primary resistor.	74/230	91
	15	R & R magnetic pick-up.	75/233	93
H.		**Maintaining the Fuel System**		
	01	Adjust carburetor anti-stall dash-pot.	76/237	93
	02	Adjust curb idle mixture.	77/240	100
	03	R & R carburetor air cleaner assembly.	78/243	100
	04	Clean carburetor air cleaner element.	79/246	89
	05	Clean automatic choke components.	80/249	98
	06	R & R anti-dieseling device.	81/252	87
	07	Adjust automatic choke.	82/255	100
	08	R & R automatic choke components.	83/258	91
	09	Free up manifold heat control valve.	84/261	87
	10	R & R manifold heat control valve.	85/264	84
	11	Adjust carburetor float.	86/268	96
	12	Adjust anti-dieseling device.	87/271	87
	13	Adjust carburetor metering rods.	88/274	87
	14	R & R accelerator pump.	89/277	76
	15	R & R carburetor.	90/280	96
	16	Rebuild carburetor.	91/284	98
	17	R & R fuel filter unit,.	92/288	100
	18	R & R electric fuel pump.	93/291	91
	19	R & R mechanical fuel pump.	94/294	96
	20	R & R electrical fuel injection components.	95/297	64
	21	R & R fuel injection nozzle (gasoline).	96/301	56
	22	R & R fuel injection pump (gas or diesel).	97/305	49
	23	Repair leaks in fuel injection pump.	98/309	31
**	24	R & R turbo-charger.	99/312	No Data
**	25	R & R fuel lines.	100/316	No Data
**	26	R & R fuel tank.	101/319	No Data

		DUTY/TASK	TASK/PAGE NUMBER	PERCENT PERFORMING
**	27	R & R fuel level sending unit	102/322	No Data
**	28	R & R fuel injection nozzle (diesel).	103/326	No Data
**	29	R & R diesel injection line.	104/330	No Data
**	30	Bleed diesel fuel system.	105/333	No Data
**	31	R & R diesel fuel filter.	106/336	No Data
**	32	Remove moisture from water separator.	107/339	No Data
I.	**Maintaining the Emission Control System**			
	01	R & R vacuum hose.	108/343	98
	02	R & R PCV valve.	109/346	98
	03	Adjust idle speed control device.	110/349	98
	04	R & R idle speed control device.	111/352	93
	05	R & R deceleration valve.	112/355	84
	06	R & R thermostatic air cleaner sensor.	113/358	93
	07	R & R thermostatic air cleaner actuator.	114/361	91
	08	Clean EGR valve.	115/364	98
	09	R & R EGR valve.	116/367	98
	10	R & R air pump.	117/370	96
	11	R & R diverter and anti-backfire valve.	118/373	91
	12	R & R closed system charcoal canister filter.	119/376	96
	13	R & R catalytic converter.	120/379	31
	14	R & R beads in the catalytic converter.	121/382	31
J.	**Maintaining the Electronic Control System**			
	01	R & R electronic control unit.	122/387	No Data
	02	R & R electronic pick-up device.	123/390	91
	03	R & R exhaust oxygen sensor.	124/393	78
	04	R & R electronic spark/timing module.	125/396	84
	05	R & R barometric pressure sensor.	126/399	53
	06	R & R manifold absolute pressure sensor.	127/402	56
	07	R & R ambient air temperature sensor.	128/405	71
	08	R & R coolant temperature sensor.	129/408	89
	09	Adjust throttle position sensor.	130/411	78
	10	R & R engine speed sensor.	131/414	71
	11	R & R road speed sensor.	132/417	62
	12	Adjust neutral/park position sensor.	133/420	64
	13	R & R anti-detonation sensor.	134/423	60
K.	**Conducting Shop Operations**			
	01	Estimate time and cost for a job	135/427	58
	02	Complete work order form.	136/430	56
	03	Update service manual file.	137/433	44
	04	Schedule customer appointments.	138/436	44
	05	Schedule outside shop work.	139/439	40

APPENDIX B

DEFINITION OF TERMS

APPENDIX B

DEFINITION OF TERMS

A number of terms frequently used in this guide may be unfamiliar to the reader; others may be familiar, but in the context of this handbook, have been assigned special meanings.

AFFECTIVE. Skills which emphasize an attitude, feeling, emotion, or degree of acceptance and rejection.

CATALOG. A comprehensive collection of performance objectives, performance guides, and related data developed in a specific domain.

CBVE (COMPETENCY-BASED VOCATIONAL EDUCATION). A methodology of instruction that (a) identifies the abilities and skills needed for on-the-job performance; (b) informs students and teachers of the precise and detailed learning objectives required to achieve these competencies; (c) emphasizes performance standards in testing, course requirements, and/or graduation; and (d) facilitates learning by letting each student master the tasks prior to advancing to another.

CHECKPOINT. A point in the development of the V-TECS product when material must be sent to V-TECS central office for quality review.

CIP (CLASSIFICATION OF INSTRUCTION PROGRAM) CODE. A code developed by the U.S. Office of Education to identify a specific cluster of related jobs for training program identification.

COGNITIVE. Skills which emphasize the recall of knowledge and development of intellectual abilities.

COMPETENCY. The ability (including knowledge, skills, and/or attitudes) to perform a specific task or duty successfully.

CONDITIONS. Describes the situation for competent task performance, including tools and equipment to be used, and limitations under which the tasks will be performed.

CONSORTIUM. A group of state agencies, institutions, or other entities which have been legally constituted through letters of commitment, agreements, or by assignment of higher authorities to work together toward the solution of problems in education. A consortium, for the purposes of this work, must have membership from autonomous agencies and institutions which cut across state boundaries as they attempt to solve problems or meet goals.

CRITERION-REFERENCED MEASURES. An evaluative procedure used to determine if a student has mastered a performance objective.

CROSS-REFERENCE TABLE. A table that identifies the relationship among duties and tasks found in the occupational inventory and the performance objectives in the final catalog. Also noted are percentages of incumbents performing the tasks by D.O.T.

CURRICULUM GUIDE. An instructional resource developed from a V-TECS catalog to guide CBVE for an occupation.

DICTIONARY OF OCCUPATIONAL TITLES (D.O.T.). A document published by the U.S. Department of Labor, Employment and Training Administration. This publication groups occupations into systematic occupational classification structures based on interrelationships of job tasks and requirements.

DISTRACTOR. An incorrect response to a multiple-choice or true/false test item.

DOMAIN (OCCUPATIONAL DOMAIN). A group of job titles that are related on the basis of required skills and knowledge.

D.O.T. CODE. A nine-digit number used to identify a specific job within a given calendar year.

DUTY. A cluster of related tasks performed by incumbent workers in an occupational domain.

ENABLING OBJECTIVE. An objective related to background knowledge or skills that are prerequisite to the mastery of a given task.

FIELD-TEST. The process of using and refining drafts of V-TECS materials for the purpose of identifying content errors or technical problems.

GUIDE SHEET. Instructional information including the duty, performance objective, task,. performance of standard, survey of standard, conditions for performance of tasks, enabling objectives, resources, teaching activities, criterion-referenced measures, and performance guide.

JOB. A group of tasks performed by a job incumbent.

JOB INCUMBENT. An individual who is currently employed in an occupation.

OCCUPATIONAL ANALYSIS (Task Analysis). The process of reviewing elements of a job for the purpose of improving training program content across program levels of vocational-technical education.

OCCUPATIONAL INVENTORY(Task Inventory Booklet). A survey instrument listing tasks performed and tools and equipment used by job incumbents in an occupational domain.

OCCUPATIONAL SURVEY. The procedures for collecting data to identify the duties and tasks that comprise one or more jobs, job types, or career field ladders for the collection and analysis of information concerning such duties.

O.E./CIP CODE. A code developed by the U.S. Office of Education to identify a specific cluster of related jobs for training program identification.

PERFORMANCE-BASED INSTRUCTION. Instruction which required the learners demonstration of specific competencies. The desired abilities are selected before the instruction is described and are clearly defined as observable performance objectives.

PERFORMANCE CHECKLIST. A list of performance steps derived from the performance guide to record acceptable or unacceptable performance of each step of a task.

PERFORMANCE GUIDE (PG). A series of steps required for performance of a task arranged in the sequence ordinarily followed.

PERFORMANCE OBJECTIVE (PO). A statement, in precise measurable terms, of a particular behavior to be exhibited by a learner under specified conditions, including a standard of performance.

PSYCHOMOTOR. Skills which emphasize manipulation of material or tools.

QUALITY REVIEW. A review of content by V-TECS staff or designated representative to examine quality of content, format, and style of V-TECS product(s).

RESOURCES. Materials which are used to develop instruction and/or learner-specific objectives.

SOURCE OF STANDARD. A person or origin from which the information establishing the standard is received.

STANDARD. The criteria used to determine if a task has been successfully or unsuccessfully performed.

STATE-OF-THE-ART REFERENCE. Current materials from which information or resources can be found to facilitate instruction.

STATE-OF THE ART (SOA) **STUDY.** Research conducted to determine the current status of performance-based instructional materials and practices in the domain area under study to obtain other information that might be useful in catalog development.

SUBJECT-MATTER EXPERT. A highly experienced person(job incumbent instructor) who assists in identifying task performance steps, skills, and knowledge necessary to perform the job.

TASK. A unit of work activity which constitutes logical and necessary steps in the performance of a duty. A task has a definite beginning and ending point in its accomplishments and generally consists of two or more definite steps.

TASK ANALYSIS. The process of reviewing elements of a job for the purpose of improving training program content across program levels of vocational technical education.

TASK CRITICALITY. That aspect of a task statement which makes its accomplishment crucial to the acceptable performance of a worker or student.

TASK LIST. A list of tasks performed by incumbents in a specific occupational domain.

TEACHING ACTIVITIES. Methods and/or procedures for delivering instructional content to students.

TEST-ITEM BANK. A collection of criterion-referenced test items coded for input and retrieval by computer or manual methods.

VALIDATION. The process of assuring that all aspects of an occupational.task analysis identifies the skills, knowledge, and attitudes performed in the occupation.

VERIFICATION. The procedure of collecting data to substantiate an existing product; for example, task list verification.

V-TECS. An acronym representing: Vocational-Technical Education Consortium of States; 795 Peachtree Street, N.E., Atlanta, Georgia 30365.

V-TECS CATALOG. An incumbent-based description of the duties, tasks, performance objectives, performance guides, and related data in a specified occupation.

WORKING CONDITIONS. The atmospheric and environmental conditions under which a worker performs a specific job.

WRITING TEAM. A team of people representing instructors with subject matter expertise; persons having knowledge and experience in developing criterion-referenced measures; local or state supervisors in the domain being developed; workers and supervisors of incumbent workers whose function is to analyze occupational data and develop performance objectives for specific D.O.T. areas.

APPENDIX C

TOOLS/EQUIPMENT/WORK AIDS

APPENDIX C

TOOLS/EQUIPMENT/WORK AIDS BY PERCENTAGE OF INCUMBENTS USING

Equipment Number	Equipment Description	Percentage Using	Number Using
12	Creeper	100.0	45
24	Float level gauge, carburetor	100.0	45
27	Gauge, spark plug gap	100.0	45
28	Gauge, vacuum-pressure	100.0	45
29	Gauges, feeler	100.0	45
30	Goggles, safety	100.0	45
32	Hammer, ball peen	100.0	45
36	Jack, floor	100.0	45
52	Pliers, needle nose	100.0	45
60	Punch and Chisel set	100.0	45
66	Screwdriver set, Phillips	100.0	45
68	Socket set, 1/4" drive, 1/8-9/16"	100.0	45
70	Socket set 3/8" drive, 1/4-15/16"	100.0	45
71	Standard, safety	100.0	45
78	Tester, circuit	100.0	45
79	Tester, compression	100.0	45
84	Tester, vacuum	100.0	45
87	Volt-ommeter	100.0	45
92	Wrench set, Allen, USS	100.0	45
17	Drill set	97.8	44
19	Drop light	97.8	44
31	Hacksaw	97.8	44
49	Pliers, ignition	97.8	44
50	Pliers, lock ring	97.8	44
57	Puller, gear and pulley	97.8	44
59	Puller, slide hammer	97.8	44
65	Screwdriver set, blade tip	97.8	44
67	Snap ring tool,	97.8	44
69	Socket set, 1/2" drive, 7/16-11/8"	97.8	44
73	Tachometer	97.8	44
77	Tester, anti-freeze	97.8	44
85	Testleads	97.8	44
89	Wire stripper and crimper	97.8	44
91	Wrench, vise grip	97.8	44
93	Wrench set, Box end, 3/8-11/4"	97.8	44
94	Wrench set, Combination, 3/8-11/4"	97.8	44
95	Wrench set, Ignition	97.8	44
96	Wrench set, Metric	97.8	44
97	Wrench set, Open end, 3/8-11/4"	97.8	44

Equipment Number	Equipment Description	Percentage Using	Number Using
1	Adjusting tool, carburetor	95.6	43
14	Cutter, tubing	95.6	43
18	Drop cord	95.6	43
20	Engine analyzer, scope	95.6	43
22	Flaring tool, tubing	95.6	43
33	Headlamp aiming kit	9526	43
51	Pliers, long nose	95.6	43
55	Prybar	95.6	43
58	Puller, seal	95.6	43
76	Tap set, rethreading, USS	95.6	43
98	Wrenches, distributor, assorted	95.6	43
2	Adjusting tool, distributor	93.3	42
4	Air compressor with fittings	93.3	42
5	Analyzer	93.3	42
6	Analyzer, electronic ignition	93.3	42
15	Dial indicator	93.3	42
16	Drill, electric, 3/8"	93.3	42
21	File set assorted	93.3	42
38	Machinists rule, 6"	93.3	42
39	Mallet, rubber	93.3	42
44	Pliers, angle nose	93.3	42
47	Pliers, diagonal cutting	93.3	42
53	Pliers, slip join	93.3	42
62	Scraper, carbon	93.3	42
64	Screwdriver, offset, Phillips	93.3	42
88	Volt-ohmeter, tach-dwell, inductive	93.3	42
37	Knife, mechanics	91.1	41
43	Oilers, assorted	91.1	41
45	Pliers, battery	91.1	41
72	Switch, remote starter	91.1	41
83	Tester, pressure	91.1	41
23	Flashlight, general purpose	88.9	40
35	Indicator, starter current	88.9	40
40	Micrometer, 0-1"	88.9	40
63	Screw extractor set	88.9	40
90	Wrench, torque, 3/8"	88.9	40
26	Gauge, radiator temp	86.7	39
56	Puller, cotter key	82.2	37
42	Nutdriver set, SAE	80.0	36
48	Pliers, end cutting	80.0	36
10	Bushing driver set	77.8	35
46	Pliers, curved nose	77.8	35
9	Brush wire, assorted	75.6	34
34	Indicator, spark plug firing	75.6	34
8	Analyzer, engine infrared	71.1	32
25	Gauge, choke angle	71.1	32
7	Analyzer, engine, dual-meter	66.7	30
41	Nutdriver set, metric	66.7	30
75	Tap set, rethreading, metric	66.7	30

Equipment Number	Equipment Description	Percentage Using	Number Using
82	Tester, PCV valve	66.7	30
13	Cutter set, gasket	62.2	28
61	Reamer kit	62.2	28
80	Rester, cylinder leakage	60.0	27
3	Adjusting tool, fuel injection	44.4	20
11	Compression tester, diesel	42.2	19
74	Tachometer, digital photo	31.1	14
86	Tune-up kit, diesel	24.4	11

STANDARD TOOL KIT

A "Standard Tool Kit" was defined by the Writing Team to included the following tools:

- Battery Post Cleaner
- Bench, Work
- Cart, Service
- Channel Lock Pliers
- Chisel and Punch Set
- Diagonal Cutting Pliers
- Drop Light
- Hammers, Assorted
- Measuring Tape
- Needle-nose Pliers, Assorted
- Scratch Awl
- Screwdriver, Phillips
- Screwdriver, Slot-head
- Slip Joint Pliers, Assorted
- Vise Grip Pliers
- Vise, Machinist
- Wrenches, Adjustable, Set
- Wrenches, Allen
- Wrenches, Box
- Wrenches, Open End and Combination Box
- Wrenches, Socket Set, 1/4 inch Drive
- Wrenches, Socket Set, 3/8 inch Drive
- Terminal Kit and Crimping Tool
- Putty Knives - Wide and Narrow
- Torque Wrench
- Soldering Kit
- Test Light with lead
- Electricians Tape
- Mechanics Wire

APPENDIX D

STATE-OF-THE-ART-LITERATURE

APPENDIX D

STATE-OF-THE-ART LITERATURE

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APPENDIX E

BIBLIOGRAPHY COMPILED BY THE SOUTH CAROLINA WRITING TEAM

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APPENDIX F

SOURCE OF STANDARD

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Writing team of incumbent workers from the State of Pennsylvania.